

~~A STUDY OF THE~~ A STUDY OF THE SPATIAL CONFIGURATION
OF TOWNS IN NORTH AFRICA

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Abdelhamid LOUMI

Bartlett School of Architecture and Planning
University College London
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ABSTRACT

The present thesis is concerned with the study of the grid structure of Arab towns found across North Africa. Studies on this kind of towns have stressed the idea of a single city form based on a three-fold hierarchical organisation of space with a specific emphasis on the cul-de-sacs; and the division of the town into a central public core and more private residential quarters. This spatial model has often provided the rationale for the design of new housing layouts. Ground plans of Arab towns, however, often show great variation in the grid structure, ranging from a very regular pattern to a strongly deformed and labyrinthine type, suggesting then that the idea of a single city type is unsatisfying. It also seems to be the case that plans of modern housing layouts based on concepts derived from this model bear little resemblance, when built, to traditional urban forms. On both counts, therefore, the model seems too abstract and too generalized to give a satisfactory account on Arab cities.

The study examines these issues in the light of a descriptive theory of urban space and argues that grid structures of Arab towns present typological tendencies and morphological individualities as well as generic properties. More particularly, it suggests that: i- underlying the grid structure of Arab towns, there are generic similarities, in that the urban fabric is highly segregated, and presents a strong regionalization of the integrating spatial structure; ii- there are strong typological differences mainly in the degree of deformation of the urban grid, in that some towns have some degree of regular structure imposed on the plan, while others clearly lack regularity; differences in the overall pattern of the integrating structures; and the degree to which the spatial structure of the quarters links to each other and to the whole fabric to form a connected structure. The study suggests that both the fundamental similarities and the deep differences in the structure of these towns arise from a single dominant factor: the degree to which the grid structure is deformed to produce firstly, a certain type and degree of movement interface between the most permanent users, i.e. the inhabitants, and visitors of the towns; and secondly a certain type and degree of movement interface among the inhabitants of the separate quarters of the town. These conclusions are then used as a basis for reconsidering some recent typical "traditionalist" design concepts, such as the clustering of dwelling units adopted in the modern layouts. Finally, the study argues that the regulation of the overall grid deformation can itself be used as a basic design concept to re-produce these types of movement interface. For this, the study explores the possibility of using a computer-based generative process of grid patterns, in which spatial properties of the grid of Arab towns have been introduced as an eventual basis for the design of housing layouts.

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INTRODUCTION:

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The study is concerned with a spatial investigation into the grid structure of traditional towns found across North Africa, along the coast, in the hinterland and in the Sahara desert. Towns of this kind found in various parts of the Islamic world, whether in Africa, the Middle East or in Asia, have been subject to generalizations and abstraction of particular cases into an ideal type, commonly accepted to be based on a three-fold hierarchical spatial organisation of public, semi-public and private; and a division of the town into two distinct parts: a central public core and a more private area divided up into distinct residential quarters.

This typological model has been adopted not only as a means to describe these towns but also as a basis in the design of modern housing layouts in an attempt to recapture the properties of their traditional counterparts. This model has gradually succeeded in firmly establishing itself in the architectural thinking since H. Fathy, the precursor of the "neo-vernacularist" trend of housing design in the Arab world, himself initiated it in the Gournia housing scheme (Fathy H., 1973, pp. 69-71) in the mid 40s'.

The accepted description of Arab city form looks ^{welcome} convincing, until architects start to use it to derive new designs on its basis. A cursory inspection of the modern housing schemes clearly shows the strong tendency for the preservation of the alleged spatial model, which once applied in its crude form seems to inevitably result in a fragmentation of the overall fabric coupled with a redundancy of

residual open space. In reality, it consists of repeated identical inward looking clusters turning their back to the main public square, bound up by roads for vehicular traffic with few buildings opening onto them. The traditional towns by contrast, do not seem to exhibit the alleged model with the same formal clarity, nor do they seem to be based on one single type. The salient characteristic which distinguishes these urban grids from the modern schemes is the complex and apparently disorderly arrangement, while at the same time presenting some common properties with respect to the grid structure; by contrast to the rigid and formal "hierarchy" of the modern layouts.

These differences suggest that there is some misreading of the grid structure of traditional Arab towns and the fundamental questions which arise are two-fold: first, to what degree the ^{المدن} alleged typological model is representative of the spatial reality of the physical form of Arab towns; and is there one single city form or are there cultural variations? And second, how useful is this model as a spatial concept in the attempt to design modern versions of traditional urban forms? The study which is therefore primarily concerned with the spatial description of existing traditional forms, also looks at the closely related issue of the current design trend of housing layouts in the context of Arab culture. It will be argued that:

→ First, the conceptual framework used in the description of the traditional urban systems appears restrictive as it does not address itself in the first instance to the urban object, and as such is likely to fail to depict the morphological differences that may exist in Arab city form. The issue of settlement type which revolved around the

question of the relationship of local parts in composing a global form, is therefore displaced and biased more towards a theory of external causation and individual experience rather than on systematic analyses of urban form.

Second, Ideas about the nature of spatial order and its possible relations to social structure in Arab towns have influenced the way in which design principles are currently defined. The notion of privacy can be identified as having been used as a primary means to describe the existing spatial patterns in these towns. The "neo-vernacularist" design trend of housing layouts appears to have been worked within the same social cause, re-embodied in prestructured functional programmes, to justify the new design concepts and establish so a strategy for the acknowledgement of the designers' expertise. It follows then that the performance of designers in their attempt to recapture properties of traditional towns is intimately related in the first instance to the study of existing urban forms, and the conceptual means by which the retrieved knowledge is then re-embodied in new design solutions. In other words, it will be argued that the problem of design is fundamentally related to the problem of spatial description.

From a descriptive point of view, space in the Islamic cities has been constantly seen as merely an expression of the society that produces it, reflecting so cultural ideals of the Muslim society, with a particular emphasis on family privacy (e.g., Burckhart T., 1976, p. 176). This view is very pervasive in the literature about Arab towns and still strongly holds as an explanation of order in such towns.

The commonly accepted characteristics of the spatial order of Arab towns can be summarized as follows: distinct urban parts compose the global structure; these correspond to i- a central public area directly linked by thoroughfares to the outside through the town gates; ii- around this public area are organised more private residential quarters where people are grouped according to religion, clan ties, village origin or affiliation to a particular religious school of law. This spatial organisation is serviced by a three-fold hierarchised sequence of open space from the most public to the most private. This view still holds as it can be found even in the most recent studies on Arab towns such as the one by Hakim (1986), in which he clearly states that:

"The system is composed of first order streets which connect all major city gates with the major city mosque and suqs centrally located..., of second order streets or major quarter streets which tend to connect between the primary streets and are the main access routes within and between the quarters..., a third order streets or main quarters' streets which provide access and linkages to areas within the quarters; and then a system of private cul-de-sacs" (Hakim B.S., 1986, p. 64).

He also refers to the quarters as the chief urban component of the city which provides accommodation for people of common ethnic background (ibid, p. 63).

From a prescriptive point of view, increasing interest has been shown in the "neo-vernacularist" design trend of housing layouts in the principle that a rational analysis of users' needs of a social organisation, embedded then in functional programmes, would ipso facto generate a design of a suitable environment to accommodate it. The spatial referent acclaimed to fulfil the social needs of a Muslim

community, particularly the need for privacy, corresponds to a layout incorporating distinct spatial devices identified as the "enclave" and the blind alley, distanced from the public area following a hierarchical sequence of the open space system. The rationale behind this spatial arrangement clearly geared towards a creation of demarcations and boundaries, is that the residential "cluster" units would by their very spatial nature exclude strangers, that is people not living in the units, while promoting at the same time social contacts among the neighbours by an increase of identity and control over their related "territory" (i.e., Fathy H., 1973, pp. 54-55).

The two lines of thought presented above which assume that on the one hand, the grid structure of Arab towns is in a large measure, hierarchical reflecting a distinct social order; and on the other, that the adopted design "cluster" principle would create the desired order in social relations, are both dealing in one way or another, with the question of the relationship of the individual arrangement of buildings and their attendant open space to the overall town structure, and the role the resulting global form plays in the definition of the patterns of social interface. Both views rely upon the assumption that there is a deterministic relationship between the built form and the pattern of social relations.

The problem with the typological model often referred to is that first, it is atomistic, in that the urban form is conceived as an aggregate of hierarchical repetition of discrete or isolated domains. It only gives a holistic view of the overall urban structure by means of a rigid and mechanical aggregative way of the local parts. Second, it adopts the basic strategy of dichotomy which divides the urban

form into two conceptual orders: the private and the public. As a result of this, the urban form is paradoxically removed from the frame of reference and study. To assume that the single need of privacy holds as an explanation of the overall spatial order in these towns denies the very fact of a possible existence of spatial variations, that is the various possible ways in which individual grid elements interlink to define larger scale arrangements in the towns. In other words, this model defined on the basis of the same social cause, presupposes similarities between individual grid structures of Arab towns; and therefore, it eliminates the very possibility of the existence of cultural variations that may exist in their configurations. The fact that the same argument of the need for privacy and its associated spatial model are used in different cultural contexts, such as in the "Essex Design Guidance", alone shows some ambiguities with respect to the adopted model.

What seems to ^{emerge} from the above views is then a certain difficulty: i- in relating social parameters to spatial structures; ii- to relate the local level of space organisation to the wider scale of the overall urban form in apparently disorderly urban structures; iii- to benefit design of new layouts from spatial description and analysis of existing built forms. In the first instance, Hillier argues for the descriptive autonomy of spatial structures, in that these should not be seen only as a simple reflection of some a priori social model (i.e., Hillier B. & Hanson J., 1984). The crucial suggestion that follows from this is that the built form is defined as real and autonomous, while at the same time originating from the social activity. The inference is that the relation of society to the built form is in a large measure lawful, and that in order to understand

that form, it is necessary to concentrate upon the form itself ^{نرد} prior to any assumption of external causative factors (Hillier B., 1987, p. 214). He writes:

"Spatial concepts drawn in the first place from the physical reality in the light of a theory of description and cross-comparative studies, once identified as a recognizable set of distinct properties, can provide a solid basis for a theory of urban types, which in return can pose in a tractable way the question of the social, economic, political and ideological determinants of the urban form" (Hillier B., 1987, p. 214).

He maintains that urban form already constitutes a social behaviour and argues that:

"the physical environment is not simply a background to social behaviour: it is itself a social behaviour; only by studying it morphologically as constituting one of the society's behavioural products could the relation between the physical environment and social life be understood. This implies that the physical environment had to be described both on its own terms and as a social product with new levels of precision and rigour" (ibid, p. 210).

In other words, a rigorous and systematic description of urban form is necessary prior to any attempt to look at its possible social dimensions. The problem encountered by past studies lies also in the difficulty of how urban parts link together to form an ordered urban whole, which in Arab towns, has been interpreted through a sequence of progressively more private domains. As a result of this characterization, the structure of the whole is conceived as a simple sum of repeated parts. This poses a serious dilemma when faced with "self-reproducing" urban systems composed with seemingly complex and disorganised intercomponent linkages, but showing an apparent

coherence at the global level, that is a sense of "wholeness". How do urban parts inter-connect to compose a well organised ^{كيفية} entity is in fact very much at the centre of town planning discourse and practice. The exclusive concern with the local dimension of urban forms may be seen, according to Hillier, as the major cause of problems of recent theories. He suggests that towns may be seen as "entities where the way in which the global structure of the grid is ^{يُشَوِّه} deformed itself gives rise to the local identities of places... The global and local are intrinsically bound up together... The global is a structure which itself creates those parts" (Hillier B., 1987, p. 215). In what way this is realized in the towns of interest remains one of the main concern of the present study.

In view of the twin emphasis -local/global and social/spatial- which characterizes, as shown above, both the past studies on traditional Arab towns and the current design trend of housing, Hillier and Hanson argue that a dual problem of description must be first solved; in that they suggest that spatial structures must be described in terms of their intrinsic social dimensions; and spatial structures must be considered as a whole and must be described in terms of their global patterns and the way in which these create spatial localities (Hillier B., Hanson J., 1984, p. 26). For this purpose, they have developed theoretically based measures which according to them might be seen to have an ^{مُتَّصِل} inherent social logic, some of which are precisely geared towards tackling the relative definition and interaction of the relationship between the local and global aspects of urban forms. The application of these analytic tools to real cases backed by numerous empirical studies, led to the suggestion that settlements by means of structuring space through the aggregation

of buildings, create and restrict encounter fields and specific patterns of movements which consistently take place. Hillier suggests that spatial relations influence the way people move through an urban system and the knowledge of some properties of these relations can show how the system will tend to be used by various categories of users. What this means is that on the one hand, a relation has been found between the local properties of urban forms and their global structure and on the other hand, between the spatial structure of a town and movement patterns. The implication of such findings is that the description of spatial properties prevalent in the configurations of Arab towns might be intrinsic to the study of the functioning of these systems, without recourse to a theory of social causation. The contention is that if the urban form is to be understood at one stage within a wider socio-cultural framework, then it ought to be possible to discover in the spatial structure of the city itself at least some evidence of its influence. ✕

From a design point of view, the major preoccupation is centred, as mentioned earlier, in the question of how the form of the whole can be built up from the aggregation of the parts. In the context of design of housing layouts, there is a concern to proceed from the description of users' needs, which are then related to a suitable building form. The successful design is therefore to find an optimal "fit" between form and function, which implies thus a relationship between the quality of the problem analysis and that of the formal solution. The consequence of this view is that emphasis is placed upon problem-analysis rather on the range of actual solutions types. Hillier, Musgrove and O'Sullivan suggest that the sheer complexity of design problems makes it necessary for the designer to structure the

problem with knowledge of solution types derived from the study of the actual (Hillier B., Musgrove J., O'Sullivan P., 1972, pp. 69-83). In other words, design solutions can be seen to be fundamentally dependent on an adequate description of existing forms. What this implies is a decisive shift from the design approaches which focus on design procedures to the study of real built forms. The inference is that if the way existing towns acquire their overall form is objectively demonstrated, then the acquired descriptive knowledge can become instrumental in the design process.

The present study is therefore primarily concerned with the identification of distinct characteristics, if anything, of the grid structure of Arab towns and establish what is distinctive about these forms that might be related to a wider social and cultural context. The second intent is to explore how design may benefit from morphological urban studies of these towns. By this the thesis aims:

First, to identify the lines of study of the so-called Arab or Islamic cities and isolate the main paradigmatic ideas embedded in the related body of literature, in order to present a preliminary assessment with respect to the conceptual framework used to describe these forms;

Second, to account in the light of the syntax theory of settlement description and methodology developed by Hillier and Hanson, for the morphological distinctive properties of the grid structure of Arab towns and the resulting social implications, using a sample of 12 towns and their urban areas;

Third, to examine some aspects of the present impasse of the "neo-vernacularism" design trend which is aimed at the conception of a modern version of Arab urban form. For this purpose, broader issues related to the current design approaches are discussed in the light of the spatial analysis of both modern housing layouts and their traditional counterparts, and explore the possible use of computer-generated models as a heuristic design basis to re-construct some underlying spatial properties of Arab towns.

The thesis is therefore divided into three main parts reflecting these aims. The first part examines a substantial body of literature concerning Islamic cities in an attempt to identify the paradigmatic ideas underlying the description of such towns. The various approaches and types of studies are briefly outlined and some assertions discussed and checked against first the evidence drawn from the presentation of the 12 towns under study. Historical and geographical background of each town is presented, followed by the description of the urban fabric and its character through a visual inspection of the ground plans and other survey material, and supported by early travellers' accounts of urban scenes. The selected towns present differences in terms of size, climate, topography and dominant historical role; in that, the sample includes towns from the north sited along the Mediterranean or Atlantic coast, towns located in the hinterland built on river banks or on mountain ridges, and towns from the south in the Sahara desert. It also includes towns once known as, capital cities (i.e. Tunis, Fez, Algiers), Holy towns (i.e. Kairwan), princely towns (i.e. Meknes) or sea and desert ports (i.e., Susa, Tangier and Wargla). The heterogeneity of the sample has been deliberately sought in an attempt to examine some theoretical

contents behind the claims which lie at the core of some approaches which attribute settlement form to environmental factors or function.

The second part deals with the spatial analysis of the grid structures of the 12 Arab towns, using the space syntax methodology for settlement description and analysis developed at the Unit of Architectural Studies, University College London, with some adaptations to the questions of interest as encountered in the present study. A detailed town-by-town analysis and their sub-areas is first carried out in order to isolate the individual characteristics of each of the 12 town grids and to investigate how parts link to form the whole. Furthermore, the towns are looked at as a group against the background of the studies of the 75 urban systems undertaken at the research unit (SERC report, 1986) in order, i- to identify a set of properties (if any) which may be recognized as distinctive features of Arab town grids; ii- to eventually refute or accept on this basis, whether these towns form a particular family of urban systems.

The spatial analysis aims also at the description of the spatial properties of the grid structure of each town and how this is likely to perform as a system of choice or control. The size of the towns in addition to the size of the sample itself made field observations of real movement patterns a rather difficult if not impossible task given the limitations of available resources. The spatial analysis which is essentially a study of urban grids is carried out with a particular attention to the relationship of the structure of the urban grid as a whole to some urban elements, such as the role of the parts in the structuring of the whole; the strength of some inter-component

spatial linkages, such as the peripheral spaces and the system of cul-de-sac passages; and finally the relation of the major town facilities to the overall grid. For this purpose, each of the 12 towns is analysed first locally by looking at the division of the towns into sub-areas (i.e., quarters), and globally, discounting alternatively each of the two urban elements; that is the systems are analysed with and without the dead-end passages and also with or without the peripheral streets. The relationship of the main town facilities, because of their association with the broader issue of urban centrality or town centre, is looked at in length in a separate chapter. Various tables and axial diagrams related to each of the 12 town grids are cross-examined, and the differences displayed are discussed.

The third and final part takes the form of a two-part epilogue, aims at the examination of some aspects of the present impasse of the "neo-vernacularist" design trend in the attempt to recapture spatial properties of Arab towns. In this respect, 7 modern housing layouts which appear to be based on the alleged traditional model, using the "cluster concept" and its associated hierarchical organisation of the street system are looked at, and the results are examined against those derived from the analysis of the 12 traditional towns. In doing so, an attempt is made to investigate the extent to which the underlying properties of two sets of spatial systems, assumed to be based both on the same type of spatial articulation, resemble or differ from each other. The articulation of the exterior open space of the modern housing layouts, is examined with the intention to show how the manipulation of spatial relations to order a desired pattern of social relations, can result in creating sometimes, unexpected situations. Against this background, an attempt is made to explore a

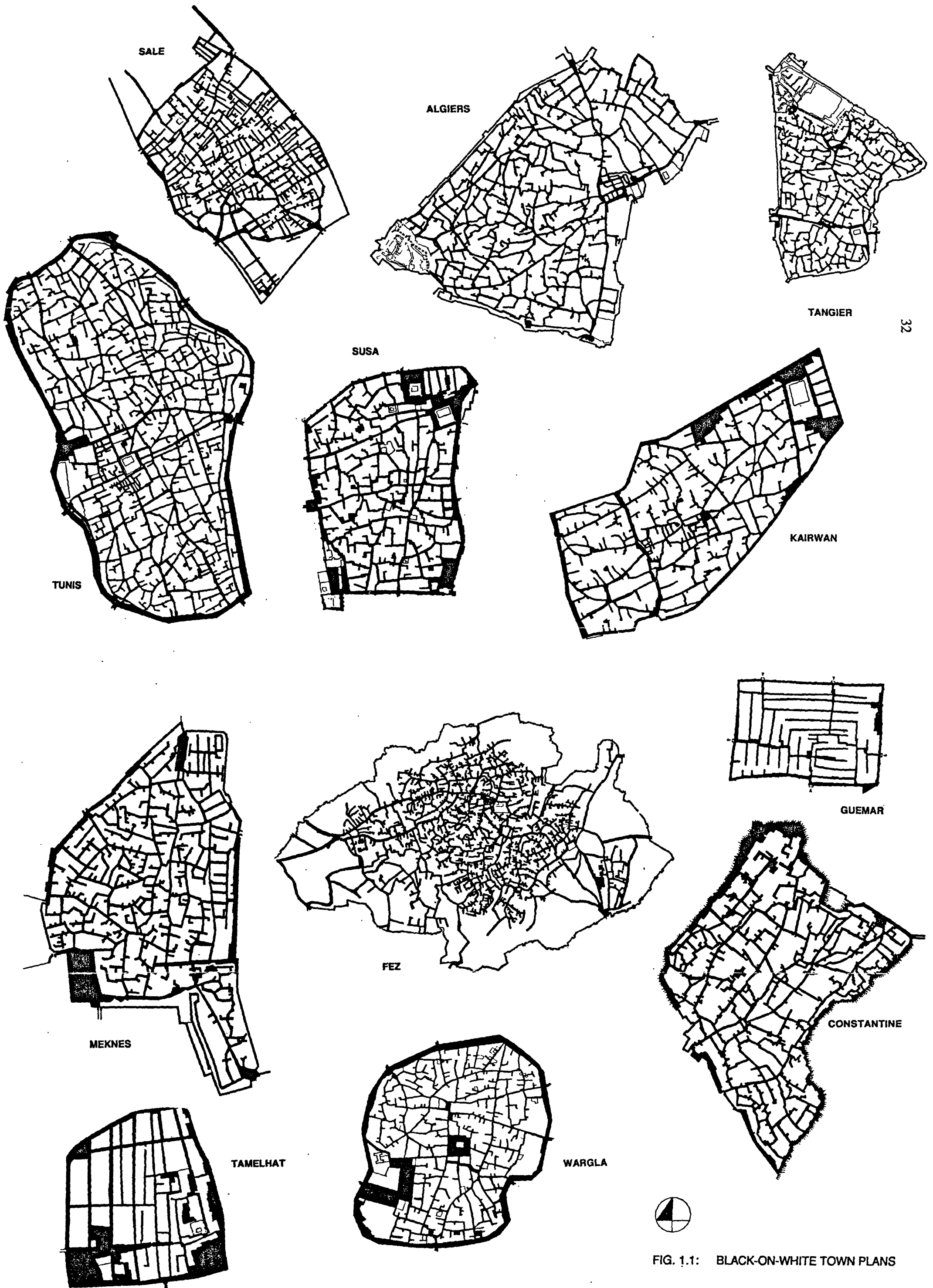
design alternative which could involve a new process for creating a global form other than on the basis of a preconceived master plan. For this purpose, the possible use of computer-generated systems has been studied and finally adapted to modern planning regulations and technical requirements of the brief used for the design of the 7 modern layouts, and the resulting housing schemes are analysed and compared to the traditional towns. This final exercise should not be considered as an end product in itself; it is only intended as a means of exploring the possibilities of using knowledge acquired on the basis of morphological studies when undertaking a design task. It is intended, in broader terms, to open up a way to explore a larger range of possible urban design strategies and also to test the design proposals before implementation.

CHAPTER ONE : PARADIGMATIC IDEAS AND THE QUESTION OF A PROTOTYPICAL CITY FORM

The present chapter addresses itself to the question of urban structure of the "so-called" Islamic cities in the light of existing literature. It aims to identify the conceptual framework used to describe the physical form of these towns; and to examine some paradigmatic ideas which have evolved concerning the definition of the structure of the urban grid and the relation of the key town facilities to it. For this purpose, a related body of literature accumulated over the past half of century is examined with the intention to set up a framework to raise relevant questions concerning the structure of the town grids which can be then investigated in the subsequent analytical chapters. It will be shown that firstly, central to the related discourse is a pervasive determinist approach which attributes the urban form to religious factors; secondly the information in hand is mostly in the form of metaphorical descriptions often obtained on the basis of a rather little hard-edged physical data, and as such its value remains unconvincing and appears of limited use in the field of urban research.

GENERAL CHARACTERISTICS OF THE 12 TOWNS:

The present study includes a sample of 12 fortified towns shown in Figure 1.1 located in different parts of North Africa, and which present great variations i- with respect to their climatic conditions, as the towns are located either on the Mediterranean or Atlantic coast (i.e., Algiers, Sale, Tangier), in the Sahara desert (i.e., Kairwan, Wargla



Guemar and Tamehlat) or in the hinterland on the ridge of mountains (i.e., Meknes, Constantine) and in valleys on river banks (i.e., Fez); ii- with respect to their function, that is towns known as capital cities (i.e., Tunis, Algiers and Fez), merchant centres (coastal or desert ports), princely towns (i.e., Meknes and Fez), religious holy towns (i.e., Kairwan) or centres of religious sectarianism (i.e., Guemar and Tamehlat), or administrative and military strongholds (i.e., Algiers, Constantine); iii- with respect to their site, that is towns built on flat ground "oasis type" (i.e., Wargla, Guemar, Tamehlat and Kairwan), on gentle slope (i.e., Tunis, Sale), on steep hills (i.e., Algiers, Meknes, Tangier) or on steep river banks (i.e., Fez). In addition to this, the towns present variations in terms of size (*).

A characteristic physical feature of the 12 towns under consideration is that they are all densely built appearing from an aerial photograph as homogeneous and compact masses of courtyard houses piled up together almost without intervening spaces, and as such exhibiting a striking sense of "wholeness" (see aerial views in Chapter Two). All of the 12 towns were (or still are) contained within their own walls with several monumental gates. These fortification walls clearly define the towns edges and their contour display the large variety of existing overall shapes of the towns (see fig. 1.2, p.). Beyond the fortifications walls deep ditches were dug in some towns (i.e., Algiers, Wargla or Constantine) which served as a first defence device of the cities. In most towns, the defensive walls are kept clear from the built fabric, allowing so peripheral streets to develop around the

(*) The areas of the 12 towns vary from 10.6 ha (Guemar) to 210 ha (Fez); for more details, the reader is referred to Table 3.1 in page .

town edges, constituting then a transit zone between the outside and the internal built fabric. In Fez and Tangier, peripheral houses or gardens are built against the walls, but only partly in Constantine, Meknes or Algiers.

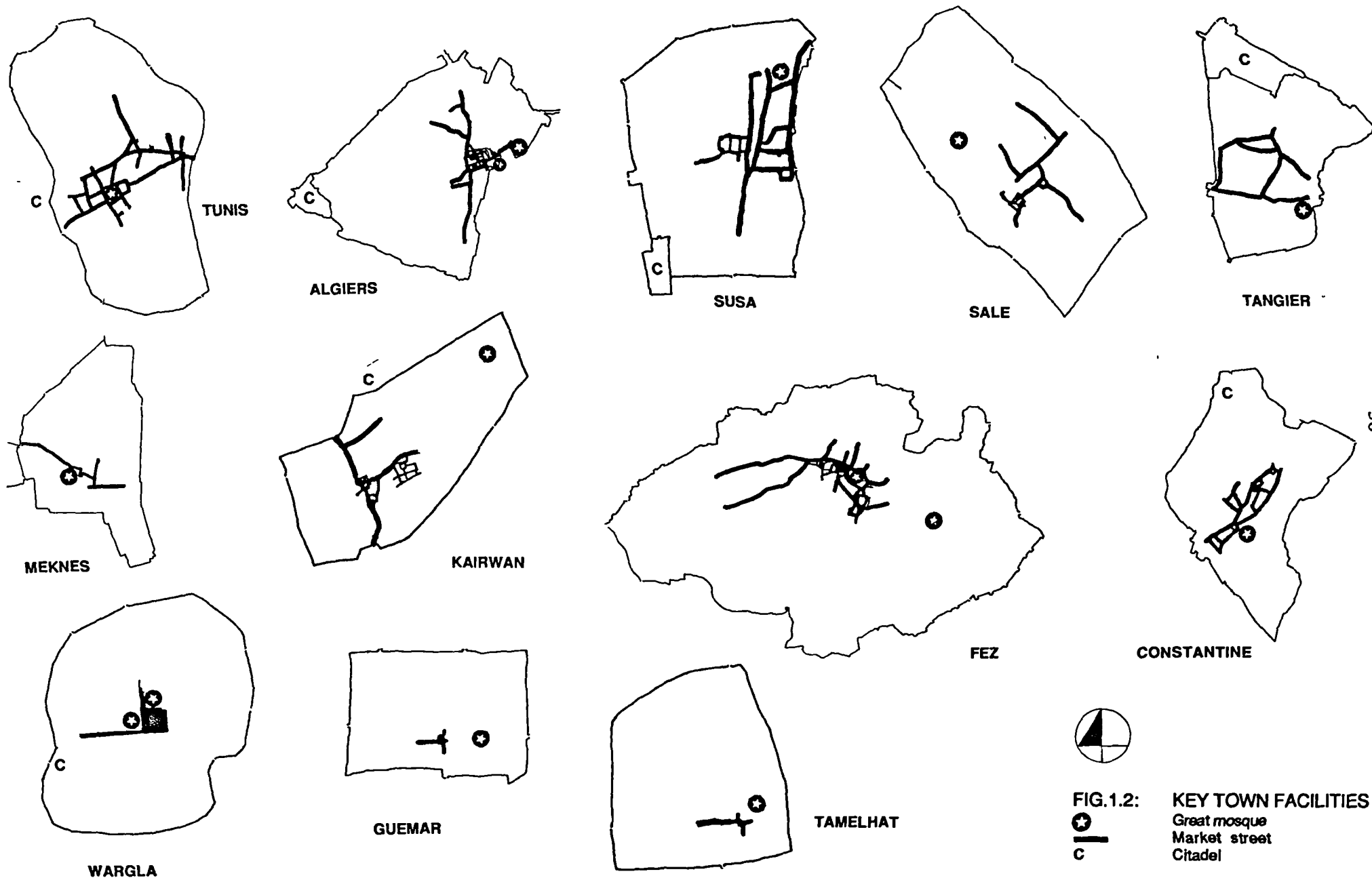
The conspicuous complex of buildings usually attached to the town walls is the citadel (*) which corresponds to the seat of political and military dignitaries and which often dominates the town by its location on a promontory in the case of hill towns (i.e., Algiers, Tangier, Constantine, Susa, Tunis). The citadel contained within its own walls the palace of the sovereign, residences of his dependants and administrative buildings (i.e. judicial court, council, fiscal services, guards barracks, mosque). In the case of princely towns such as Fez and Meknes, the citadel develops into an entire imperial quarter containing within its own walls palaces, pleasure gardens and parade grounds. In some towns such as Sale, Guemar and Tamelhat, this town feature is lacking.

It is the great mosque in reality, which by virtue of its size and architectural form, dominates the silhouette of the Arab town constituting a major urban landmark within the walls. The great mosque is a place of worship as much as a place of social gathering and official proclamations. Juridical and scholarly activities are conducted inside it and in some cases schools and colleges are annexed (i.e. Fez, Tunis, Guemar and Tamelhat), to form in large towns such as Fez and Tunis an institution at the scale of a university. The

(*) The citadel is commonly termed "Casbah" in towns which have been under Ottoman influence.

great mosque as a major religious place of regular daily worship is often found placed along a main road, but there is a good deal of variation with respect to its location within the overall built fabric (see fig. 1.2). In several towns such as Kairwan, Susa, Algiers, Tangier, it is found at the edge of the town, beyond the fortification walls presenting then a clear urban de-centring. The Great Mosque appears to occupy the topographical centre of the town only in few cases (i.e. Tunis, Wargla, Fez).

Every aspect of day-to-day life, craft production and trading are often found in the vicinity of the Great Mosque (i.e. Tunis, Fez, Wargla, Tangier, Algiers). The market of luxury goods (i.e., jewels, silk, furs, carpets) (*) recognizable by a regular chequer-board pattern of its streets in the large towns (see Ground Plans of Tunis, Fez, Algiers, Kairwan in Chapter Two), constituted the centre of the trading quarter. The markets develop linearly along streets, thoroughfares joining in some cases two opposite town gates such as the case of Tangier, Kairwan, Algiers, Tunis (see fig. 1.2); at town gates and even at the periphery where are found trades whose proximity might be undesirable (i.e., wool-dyers and tanners). There is also a common tendency for small commercial groupings to develop at the heart of the areas where economic life is kept at its simplest. In reality, the economic life as much as the religious life in Islamic towns were rarely confined to one single area. Although admittedly at a small scale, they often penetrate the residential areas, reach the fortification walls and town gates and go beyond the walls, the gates and in the cemeteries. In other words, the removal of the seat of political power from the main economic district, the dissociation of



commercial streets, the distribution of the local mosques and shrines, public baths, warehouses and local markets on the overall urban surface all contribute to the creation of nuclei of various importance.

It is common to find within essentially residential sections of the towns some institutions required for social life. As a new city develops or an old one expanded immigrants tend to settle in groups according to town or village origin such as for instance the Moors in Tunis and Fez or the Turks in Algiers; to Muslim sectarian affiliation or religious identity such as the Jews in Tunis, Sale, or the Christians in Tunis; to clan ties such as in Wargla. There was also an economic basis for the homogeneity of particular quarters named according to a dominant occupation of its inhabitants which drew them together such as in Tunis and Fez. Social and administrative cohesiveness naturally extended to communal defense which required during social unrest and internal conflicts, the erection of physical boundaries as the final step towards totally sealing off the quarters from each other, to loosen again gradually when security is regained. For instance, although it is known that various quarters of each of the 12 towns were named, it has been possible to define their limits only in the case of some towns (see Chapter Two).

A cursory inspection of the town plans in Figure 1.1 hardly shows any morphological features which could differentiate the quarters. Only the town as a whole, presents itself as a distinctive physical unit constructed within the space defined by the surrounding walls. Inside

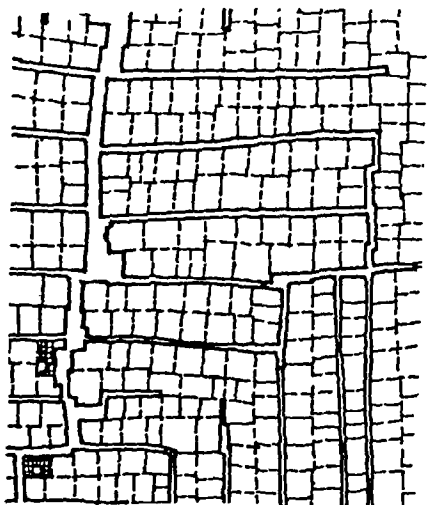
that area, the endless variety of shapes and sizes of urban blocks (*) result in town grids with a varying degree of deformation, ranging from the most irregular and intricate labyrinth-like pattern (i.e., Fez, Algiers), to a more regular almost perfect orthogonal layout (i.e., Guemar, Tamelhat; see fig. 1.1). The systems of streets, primarily for pedestrians and pack animals use only, do not conform to any general model of transportation as they seem to have developed creeping out and steadily ramifying. The narrow streets which continuously twist in and out, are tortuous to the extreme in some parts more than others like the passages of a maze seldom punctuated by squares (see plans, fig. 1.1). There are buildings spanning over some streets creating covered passageways, appearing like tunnels when exceeding a certain length (*). There is hardly any planned visual articulation by means of squares or long range views to specific monuments. However, each town seems to present a various number of major arteries linking the trading areas to some town gates. Because of the heavy traffic they carry (porters, pack animals, pedestrians including visitors), these thoroughfares along some of which develop the bazaars such as in Tunis, Algiers, Tangier, Fez and Kairwan tend to be wider and also to run in some cases in an interrupted way defining long routes made of a series of segments of streets of various length interconnecting at open angles. The location and overall spatial configuration of the kind of structure they form when linking to each other and to the town gates vary greatly from one town to another. In some cases, it

(*) A block is defined as an island constituted by a group of contiguous courtyard houses, surrounded on all sides by streets and into which may extend dead-end passages

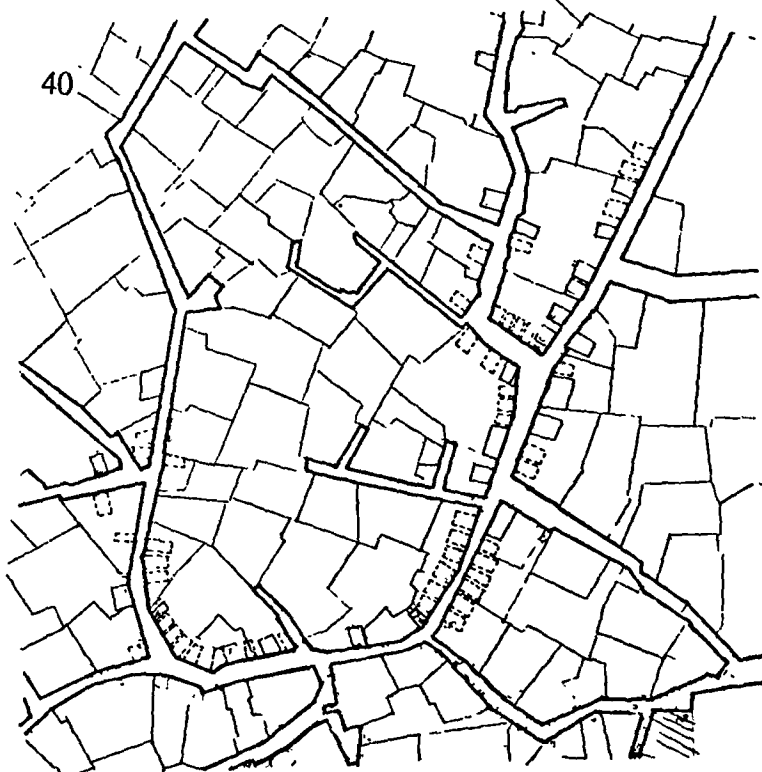
(*) According to Hakim, 15.5% of the street system length of Tunis is covered by vaults and buildings bridging over (Hakim B., 1986, p.116). In Wargla, the street system is covered on 137 different places.

develops partly along the periphery (i.e., Kairwan and Susa); while in others, they run across the townscape (i.e., Wargla, Tunis and Fez), cutting in some cases in the middle of quarters (i.e. Tunis, Wargla). Alleys of various length connect to thoroughfares and to each other in endless ways. Dead-end passages, some of which cut deep inside the urban blocks presenting sharp turns (i.e. Fez, Algiers, Tunis), are found indiscriminately along both thoroughfares and alleys (*). These cul-de-sac passages provide access to only a limited number of buildings, which is in Tunis for example, under the third of the total number of buildings (Hakim, 1986, p.116). Indeed, it can be easily observed in most of the towns, that several urban blocks, perhaps not the largest, do not present that dead-end feature at all. For example, Figure 1.3 shows a detailed layout of a series of urban blocks from Tunis, Wargla, Algiers, Guemar and Tamelhat in which the houses open out directly to the street. Even when urban blocks display dead-ends, these are usually used to service houses inside the block, but the houses at the periphery are directly accessible from the streets surrounding the block. As a result, streets in these towns are in a large measure, constituted by building entrances. This can be clearly seen from the detailed plans of some blocks of the towns, which show irregular blocks in size and in shape, chiefly composed of irregular plots also of various sizes, haphazardly arranged. In fact, none of the blocks resemble the other and the dense packing is the norm in these towns. This intensive development is clearly demonstrated by the

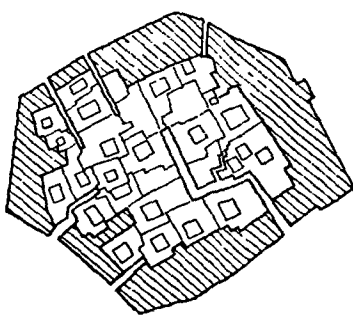
(*) According to Raymond, the total length of the blind alleys in Algiers constitutes 50% of the total street network length (Raymond A., 1984, p. 15); while in Tunis and according to Hakim, the total length of these blind alleys represents only 13.3% (Hakim B., 1986, p. 116) and probably even less in towns like Guemar and Tamelhat.



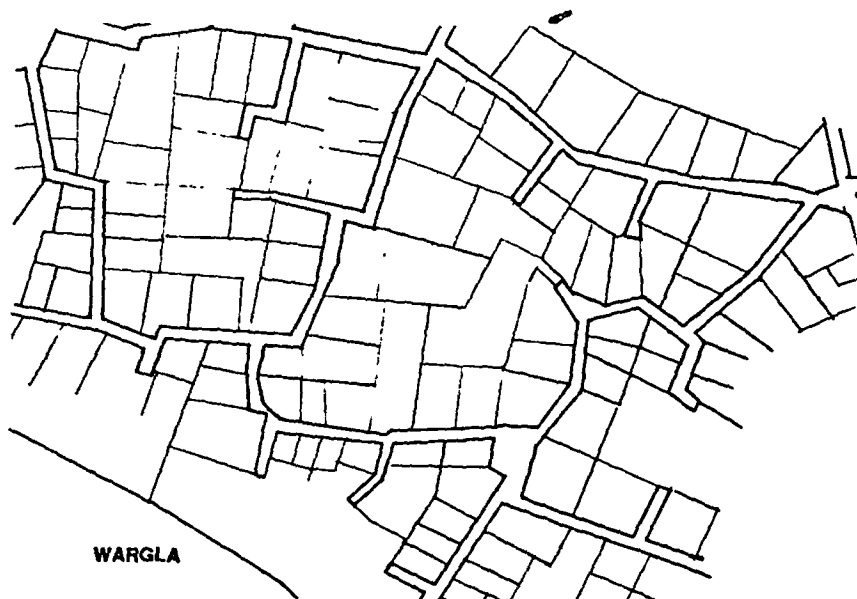
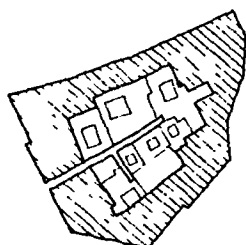
GUEMAR



ALGIERS



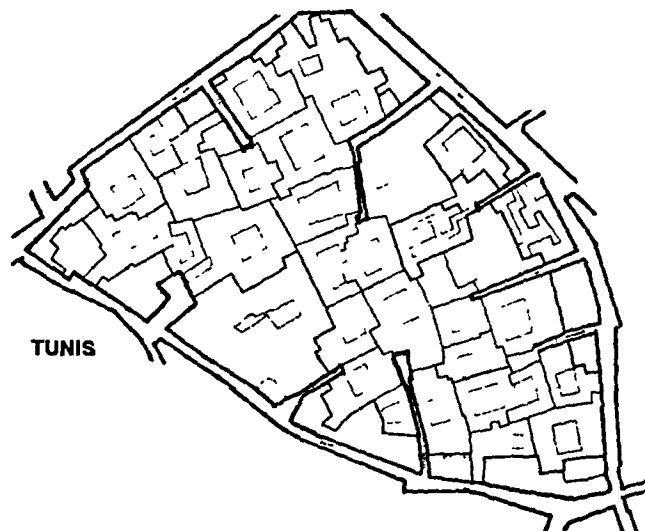
TUNIS



WARGLA



TAMEGHAT



TUNIS

FIG. 1.3: URBAN BLOCKS

lack of redundant or residual open space of the streets. This property will be seen of a fundamental importance in the discussion of the modern layouts, where the major problem seems to result from the loss of such direct contact between the street and the houses.

Houses in all towns without exception open out into an inner court, but differences occur in the number of storeys of the buildings. For example, in Guemar and Tamelhat, buildings are only one-storey high with domed roofs; while in Wargla, they are usually two-storeys and up to three-storeys high in Algiers, Tunis and Fez with roof terraces. Street decoration and building ornamentation is almost inexistent, and is usually limited to mosques, palaces, courts, town gates, public building entrances.

PERSPECTIVE INTO PAST STUDIES:

Studies on towns of this kind accumulated over the past decades can be clearly laid out in two major classes. The first is more concerned with generalizations and the presentation of the ideal city, on the basis of either a limited number of cases across a particular region, such as Le Tourneau's "Islamic cities of North Africa" (Le Tourneau, 1957) where he bases all his work only on two towns in Morocco (Fez and Marrakech); Balbas' "Islamic cities of Spain" (Balbas T., 1942, pp. 6-30) and Lapidus' "Middle Eastern cities"; or within a specific historical period such as "Cities during the late Middle Ages", "The Medieval Orient" (i.e., Clerget, 1931, pp. 282-283; Bruschvig R., 1947, pp. 127-155), Arab cities during the Mamluk period (i.e., Lapidus I. M., 1961) or during the Ottoman period (i.e. Raymond A., 1984). All what

it comes down to in these studies is that they all postulate the existence of a prototypical city form on the basis of little physical data.

The second type of studies takes the form of detailed monographs focussing on individual towns, and in some cases only on a particular aspect such as the historical development, social organisation, domestic space or public buildings. This kind of data, although providing some valuable information, is presented in a way which does not allow systematic cross-comparative analyses which can provide a basis to establish some generalizations. Examples of this type of studies were those written about Aleppo (Sauvaget J., 1941), Cairo (Abu Lughod J., 1984; Clerget, 1931), Fez (Letourneau R., 1957), and the more recent studies on Sanaa (Lewcock R. B. and Serjeant R.B., 1980) and Tunis (Hakim B. S., 1986).

However, much of the recent work on the physical structure of Arab towns has been undertaken within a particular framework where religion, for an ideal Islamic society, is often seen as inseparable not only from social behaviour but also fundamentally related to the physical arrangement of the towns. In this context, it appears that the general trend which sees the full exercise of the cult necessarily demanding an ideal city form, has contributed to a certain extent to orientate the studies on Arab towns within a particular line of thought.

This approach which assigns the physical structure of the Arab towns to a single cause (religion) seems to have little challenge. Studies on Islamic city such as those by Aubin, Scanlon, Roberts, Ettinghausen

to name only few, who while clearly rejecting this well entrenched religious determinist idea, do not come forward with an alternative to the raised problem. However, the rare revisionist approach, if it may be called so, suggest that there is more than one factor (i.e. religious factor) that can influence city form (i.e., physical and historical factors), de-emphasizing therefore the single role of religion as acknowledged by the Orientalists (i.e. Hourani A. H., 1970). In this respect, Hourani writes that:

"It would be a mistake to try to see that the physical shape of the Islamic city simply as an expression of its social structures... A city cannot be just an external sign of a system of social ethics or social institutions." (Hourani A. H., 1970, p. 20).

Elsewhere, he writes that there are many other factors which affect the shape of the Islamic city, the physical factors being primary among them (Ibid, p. 21). Adams also argues that culture is neither static through time nor constant as one moves from region to region within the "immense congeries of diverse people and geographic settings that constitute Islam" (Adams R.M., 1968, p. 195). He goes on to suggest that because of this, temporal and regional differences in Islamic cities should be expected (Ibid, p. 195). Lapidus also rejecting these generalizations about Arab city patterns on the basis of a common religion, points to the consideration of the regional and temporal diversities, as these might affect the pattern of the Arab towns (Lapidus I.M., 1969, p. 148). Yet, he goes on to say that "certain features of geography and social structure seem to have been held in common and differences in detail do not vitiate all efforts of generalizations" (Ibid, p. 148). Fathi, on his part suggests that in

addition to social institutions, climate is another important factor in the structuring of Arab city; he writes:

"As climate was [also] the dominant factor affecting architecture and town planning, it is not surprising that we find a marked uniformity in the development of urbanization. From the time of Arab invasion until the later part of the Turkish period, all cities in this vast region bore a great similarity to one another..." (Fathy H., 1973, p. 320).

Hakim in his study on planning regulations in Islamic cities believes on one the hand on the interaction of several factors (cultural, physical and technological) underlying the Arab city form, but on the other, he suggests that because these latter do not vary from one region to another, therefore one can presume the existence of a single city form across the Islamic World. He writes:

"in addition to the identical socio-cultural framework created by Islam, the similarity of climatic conditions and construction techniques within most of the Islamic world helped to produce remarkable similarities in approach to the city building process. This resulted in the frequent occurrence of the familiar beehive urban pattern throughout the vast geographic area." (Hakim B. S., 1986, p. 16).

However, whatever the driving force behind the Arab city form referred to by either the "Orientalist" or the "Revisionist" tendency, both fall back into easy generalizations and acknowledge the existence of a prototypical city form. Their concern has been to explain the peculiarities of the spatial structure of Arab towns in terms of factors which are external to the urban form itself, often remaining silent with regard to the local differences each town exhibits, some of which can be grasped from a simple visual cross-

comparison of town plans (see fig. 1.1). The information produced by these studies is founded on the assumption that an Islamic city comprises a distinct society and culture and particular aspects of administration and religious organisation, and therefore this necessarily makes its spatial structure different and distinct. The exponents of the notion of this pan-Islamic urban order, maintain that the Arab city is characterized by a complete absence of city state and complete lack of municipal government and institutions, and the spatial arrangement is determined by the fact that the city is commonly for Islam, since it is only there that the virtuous life as the religion conceives it can be fully lived.

There has been nevertheless some attempts to play down the popular idea of a single city form by identifying instead several distinct groups of Arab towns according to either their origin of foundation, that is whether the city has grown spontaneously or has been originally "created" by a deliberate act of a ruler; or according to their function, that is as to whether the city is predominantly a commercial, administrative, religious or military centre. For instance, Scanlon argues that differences between towns in the Arab World must not be overlooked and suggests that "we must attend distinctions in character which evolve from historical placement" (Scanlon G.T., 1970, p. 180). Brown also points to the importance of the origin of foundation of the towns and writes:

"...Of course, there were individual variations in city spatial organisations. To use the classification adopted by some urban historians, certain Near Eastern cities were "spontaneous"; others were "created". That is, some had grown slowly over time, adapting in the process of new circumstances and changing

dynasties; others had been deliberately created by a political sovereign..." (Brown L.C., 1973, p. 35).

This distinction between "spontaneous" and "created" to which many writers about Islamic cities referred to (i.e., Marcais G., Pauty E., Planhol X., Mseffer, Lasner, Grunebaum G.E.V., Elisseeff N.) is only descriptive in interest, and there has been no attempt to see for example, its implications on the physical structure of the cities. The classification of towns according to their dominant function has also been used in the past studies, with little evidence provided at the level of the spatial configuration. For example, Issawi writes that:

"Many of those [Islamic cities] founded by the Arab were camps (ribat) on the edges of the desert -i.e. Basra, Kufa, Fustat, Kairwan. Others had already served for many centuries as 'desert quts', handling caravan traffic, as did Damascus, Aleppo... Others were royal cities, like Sanaa, Bagdad, Cairo and Meknes." (Issawi C., 1973, p. 107).

Hourani also suggests that cities can be distinguished according to their function; he writes that there are cities with a special function such as desert or sea ports, which are devoted to the carrying rather than the making of goods; or holy cities, which are centres of worship, pilgrimage or religious learning; while other cities may have many functions which both manufacture and distribute many types of goods and which are also centres of secular as well as religious activities (Hourani A.H., 1970, p. 9). It is useful to know the historical conditions in which the urban form is embedded; it is also useful to know the main activities taking place in the town, but it seems difficult to explain for example, the apparent similarities in the street configuration between the capital city of Algiers and the

provincial town of Tangier; or the differences in the structure of the urban grid of the two religious centres of Kairwan and Guemar as could be clearly seen from the ground plans in Figure 1.1. Therefore, it seems rather presumptuous to try to typify the spatial structure of the cities on the basis of extraneous elements such as a single function, which in itself is neither static nor specific in most of the cases, as changes always occur over time; or in terms of the general climatic conditions which contrarily to what is often assumed, are not identical across the Islamic world.

The following section will concentrate mainly on issues raised by past studies, relating specifically to the structure of the urban grid of Arab towns and the relationship of the major town facilities to the grid. Much of the recent work on the physical structure of Arab towns has emphasized four characteristics in the structuring of space. These are the division of the city into two separate domains, the public and the private; the division of the city into distinct quarters; the three-fold hierarchical organisation of the street system and the centrality of the public facilities, especially the great mosque and the market streets. These four features relate to more general architectural issues about the structure of towns and the way in which "parts" interact spatially to compose the overall structure; the street pattern and the question of centrality.

THE QUESTION OF OVERALL STRUCTURE AND THE IDEA OF PRIVATE AND PUBLIC CITY:

The phenomenon that is widely accepted as a fundamental characteristic of the physical and social structure of Arab towns is the pronounced differentiation between the trading sections -that is the public- and the residential districts -that is the private-. This differentiation is often seen as a socio-cultural characteristic, inevitably resulting from religious requirements. It is argued by many writers that the right of the Muslim family to live enclosed in its house has led, as Balbas pointed out, to a clear separation between public and private life; this latter concentrating in the inner courtyard and not turned towards the street (Balbas T., 1942, p. 26). In this respect, Marcais writes that Islam explains well the differentiation between the commercial and the residential quarters. According to Marcais, a house as a rule, cannot be conceived to be located in the middle of a commercial quarter, but it will be as enclosed as possible, or it will be grouped with other cells of the same nature, all benefiting from privacy (Marcais G., 1940, p. 31). To Planhol, the Muslim town obeys a number of well defined rules, one of which is the concentric arrangement and hierarchical division of the different quarters, commercial district and residential areas (Planhol X., 1957, p. 9). Similarly, Burckhardt comments that:

"there is a third factor which distinguishes a Muslim town from a Christian one, namely the separation of commercial quarters from residential areas and, more generally, of the public from the private domain. All professional activities are sited around the central market place or along the arteries leading to it, whereas the residential quarters, as it were, turn their back on the traffic" (Burckhardt T., 1976, p. 176).

Noe describing a "typical Islamic urban structure" also points to the clear separation between the public and private areas of the Muslim city, with the residential areas "located behind or beyond the commercial areas and are segregated according to their various populations groups" (Noe S. V., 1980, p. 73). To English in his description of an Afghan Muslim city, the irregularity of the city quarters highlights a particular relation between urban structure and society which is widespread throughout the Muslim world, where the public and private space are clearly differentiated (English P.W, 1973, p. 77). In a more recent work on Islamic cities, Raymond refers to the same spatial feature as being as a fundamental property of Arab cities when he writes:

"The phenomenon that is fundamental is the pronounced differentiation apparent in all these great cities between districts of large scale economic activity, and residential districts" (Raymond A., 1985, p. 10).

Elsewhere, he clearly states that this conception of a distinctly divided space of a public city as opposed to a private one can be read from town plans where two types of street network appear quite clearly (Ibid, p. 12). This is certainly not always the case for all cities, as will be seen in the chapter dealing with the presentation of the morphological properties of the towns of interest.

Similarly, Lapidus suggests that in cities in the Arab world, the emphasis on privacy and security was most pronounced; these "can be divided between the parts which were suqs (markets) and residential quarters" (Lapidus I. M., p. 63). Whilst, Balbas explains that the "zoning concept" in modern planning is not a recent invention, but has

been in use in Medieval times in the structuring of Muslim towns in Spain (Balbas T., 1942, p. 27).

The idea that the Arab city is, as a rule, divided up into public (i.e., markets) and private domains (i.e. residential quarters), mainly to ensure maximum protection and privacy to the family life is well entrenched in the studies on Arab towns. Although it is a fact that some districts were primarily residential; while others remained purely commercial, this urban dichotomy can also be observed in most of the towns regardless of their cultural context. This is not to say however, that no one resided in the market sections or that no economic activities were carried out in the residential quarters. The diagrams in Figure 1.2 show that in almost all towns, the main commercial activities tend to develop linearly along streets, often more regular in their configuration and in some towns, extending to the town gates. As the town grows, more public buildings (i.e., local mosques, public baths, religious schools) are erected in various parts of the town. Small commercial groupings (i.e. baker, grocer, charcoal sellers) tend to develop even in the heart of the residential quarters.

What follows from this is not an attempt to challenge the existing concentration of the main public facilities in one area as any urban system would always exhibit areas that are either more residential or more commercial than others. The problem is that the acknowledged pronounced differentiation between the public parts and the more residential areas has been accounted for with a complete disregard to the various ways this phenomenon takes place in each town. The question that follows is: to what extent is this characterization

adequate for understanding for example, the variation in the structure of the urban grid between Fez and Kairwan, or Guemar and Algiers?

THE DIVISION OF THE URBAN FABRIC INTO DISTINCT QUARTERS:

The second characteristic repeatedly acknowledged as prevalent in the physical arrangement of Arab cities is the strong division of the urban fabric into self-contained units along ethnic, religious or professional lines. That is, the physical form of the town as a whole is conceived as a grouping of distinct quarters, inhabited by distinct social groups. For instance, Planhol asserts that one of the characteristics of Islamic towns is the segregation into districts of different ethnic and religious groups; he states that "everywhere residential districts are divided into closed units, consisting of lateral courtyards and alleys leading off a main street" (Planhol X., 1957, p. 13). In Hassan's terms, the quarter in Muslim cities is an urban locality or neighbourhood unit, which is inhabited by a closely related solidarity. He presents the quarter as a "functional equivalent to the natural areas found in the modern industrial cities" (Hassan R., 1972, p. 111). According to Hassan,

"the residential pattern in Muslim cities was characterized by the segregation of the various population groups. Each group occupied its own quarter and different quarters were therefore inhabited by homogeneous groups. The number of quarters in the city depended upon the extent of the social heterogeneity of its population" (Ibid, p. 111).

Ismail assigns the quarter phenomenon to a pre-Islamic origin, where the nomadic Muslim society was organised into tribes, and which was

fully adopted in the late Middle Ages, and as a result, Islamic Arab cities became divided into distinct quarters which according to him, maintained a solidarity and were closely-knit and homogeneous entities (Ismail A. A., 1972, p. 116). He also describes the quarter as a self-sufficient neighbourhood which was able to live independently when necessary (Ibid, p. 116). Similarly, Grunebaum maintains that the quarter phenomenon in Arab cities, originated from the tribal organisation of the nomadic population which settled in towns. He writes:

"In their newly founded cities, the Arab would settle by tribe, each tribal quarter to be completed with its own mosque, bath... Not infrequently, the individual quarters are walled and their gates locked during the night" (Grunebaum G. E. V., 1955, pp. 147-150).

Burckhardt also attributes the division of the city into quarters as a result of tribal groupings (Burckhardt T., 1976, p. 188). To Roberts, defence is the main driving force behind the division of the town into quarters; he writes:

"In an almost all-like structure, the Muslim town was set within its walls, as a first line of protection from the environment... The residential quarters often within their own walls, were then located close together in a pattern which afforded mutual protection of each building by all the others" (Roberts H., 1979, p. 39).

While, according to Lapidus, it is the lack of municipal institutions in the social life of Muslim cities which reinforced the division of the town into quarters (Lapidus I.M., 1970, p. 199). Elsewhere, he

describes the quarters seen both as social solidarities as well as geographical entities, as the basic units of society. He writes that:

"In Islamic cities, all groups of people who believed themselves bound together by fundamental ties -family, clientage, common village origin, ethnic or sectarian religious identity- lived in those neighbourhoods... The quarters were village-like communities within the urban whole" (ibid, p. 49).

Lynch also generated his description of an Islamic city when he comments:

"Each ward [quarter] of the city has its mosque and its essential services. People of different incomes live close by each other, but ethnic and religious group may be separated in distinctive quarters" (Lynch K., 1981, p. 384).

Hakim identifying the distinctive components of the "Arab-Muslim city" points to the quarter as an important urban element within the scale of the overall city, that provided accommodation for people of common ethnic or socio-cultural tribal background (Hakim B. S., 1986, p. 63). To Serageldin, the quarters are an ancient and ubiquitous phenomenon in Islam, and as knit-group providing consciousness of social identity and security (Serageldin I. and El-Sadek S., 1981, p. 165).

Literature on this particular point is paramount as demonstrated by the above references which clearly show the pervasiveness of this notion in the description of the urban structure in Arab towns. It seems difficult to maintain the idea of the city as chiefly composed by separate spatial units, as a casual examination of the ground plans (see fig. 1.1) indicates on the contrary a striking "organic unity", and

no obvious physical boundaries, nor differentiation in morphological terms between various sections of the town. However, the division of the towns into quarters to which many authors referred to, may correspond to distinct social groups who co-existed and formed homogeneous communities, whose separateness was further maintained not necessarily by physical boundaries, but on the more permanent basis of socio-cultural factors (i.e. religious affiliation, ethnicity, town or village origin) and administrative methods of tax collection, water supply, street maintenance. Despite the fact that it is known that these social groups initially shut themselves off within their own walls and gates mainly during times of public un-rest and insecurity, it has been commonly maintained, regardless to the related historical conjecture, that an Arab town is as a rule, divided up into separate quarters. The town plans shown in Figure 1.1 do not seem to exhibit any major morphological differences between various areas, but the question which arises is to see how this subdivision into areas is reflected in the structure of the town grids.

From a conceptual point of view, these studies emphasize yet again, general similarities, although many of these observations have been generated without reference to particular towns. At this stage, it seems reasonable to suggest that these claims about the correspondence between the Islamic social and spatial systems is symptomatic of an uncritical attitude of a generalized theoretical model, and as such is likely to provide limited understanding of the real nature of the spatial structuring in these towns. These assertions say perhaps more about the nature of evidence used to reinforce abstract models than about the way these towns achieve their "wholeness". However, these studies did in fact address

questions about the relation between the local level of organisation and the overall structure in these towns which seems to have been tackled by simply relating these differential orders to social structures.

THE STREET SYSTEM SEEN AS A HIERARCHISED SEQUENCE:

The third characteristic persistently stressed in the literature about Arab towns is the hierarchical organisation of open space. The street system has been said to be based on a three-fold hierarchical model, from the most public thoroughfares linking the city gates, across the semi-public streets which give access to the separate quarters, to the more private small alleys and dead-ends which lead to the houses. For instance, as early as 1942, Balbas was stressing this socio-spatial model as an underlying spatial principle of the Islamic cities of Spain (Balbas L., 1942, p. 13). Lynch describing the essential characteristics of the Islamic cities, comments that

"the ruling metaphor is the container: everything is walled and gated, from the city itself, to wards and quarters of the city, to local residential clusters, to the house and its rooms. Even the major public ways are tightly confined. They lead to yet smaller local streets, which lead to extremely narrow culs-de-sac like capillaries, which lead to private doors, which lead by tight dog-leg corridors to private patios, rooms, and terraces. This arboreal systems of streets is everywhere... The city is a solid built volume, in which hollows and lanes have been excavated, in contrast to our picture of a city as a collection of volumes set in an open ground..."(Lynch K., 1981, pp. 381-384).

Antoniou also notes that the structure of the Arab city pattern is based on a controlled hierarchy of roads, with cul-de-sacs providing access to residential blocks (Antoniou J., 1983, p. 45). According to Hakim, the circulation in Arab cities is handled by a "four-level" order streets, with the first-order streets connecting the system to the major town gates, the second-order streets corresponding to the major quarters' streets the third-order streets to the minor quarters' streets, and finally a system of private cul-de-sacs (Hakim B., 1986, p. 64).

Rapoport also maintains that the physical structure of the Islamic city is organised according to a tree-pattern, which is a reflection of the social structures (Rapoport A., 1969, p. 63 and 73). Serageldin claims that the Islamic concern for privacy and the clear separation of public from private life by a hierarchical sequence of progressively more private spaces, was the dominant force in shaping the buildings and interconnecting spaces in Jeddah (Symposium, ed. Serageldin I. & El-Sadek S., 1981, p. 4). To Delaval, the circulation pattern functions as a social control mechanism, where

"the houses are connected to the central market place by narrow alleys forming a tree-structure... From the public space of the market to the private space of the patio inside the house, each intersection of the circulation network marks a distinct transition point and creates, with a narrowing of the alley, an increase of privacy" (Delaval B., 1979, p. 254).

What seems to be argued is the primacy of the physical spatial organisation in the social control, and the importance of space in generating and maintaining distinct patterns of social relations. Abu-Lughod clearly states this argument when he writes that:

"There are recurring idioms which were functionally suited to the social structure commonly found within Islamic cities... Among those idioms is the tri-fold (rather than the more 'western' bi-fold) division of space into private, controlled semi-private and public" (Abu Lughod J., 1980, p. 6).

Fonseca describes the typical Islamic city dweller as moving through a series of spatial enclaves, from the most private and individualistic to the most public and plural (Fonseca R., 1971, pp. 72-77). Similarly, Khan maintains that in the traditional pattern, there is a definite hierarchical order in the formation of the alleyways. According to Khan,

"main alleyways enclose large blocks of houses, which in turn, are divided into smaller blocks by narrow streets that finally lead to closed dead-ends which provide more security for their inhabitants, because they exclude all strangers and passers by" (Khan S. M., Symposium paper, ed. Serageldin I. and El-Sadek S., 1981, p. 164).

Clearly, This characterization of the street system appears limiting as it results again from premature over-generalizations. The problem lies not in the fact that there are variations in the configuration of elements of the street system, such as cul-de-sac passages, twisting narrow alleys, thoroughfares or even some aspects of their arrangement which are acknowledged to be common to all towns, although their number, location and pattern vary considerably. What seems to be more puzzling is the fact that these street elements are described as inter-relating in a systematic way to define a single entity. A simple examination of the town plans (see fig. 1.1) shows sets of totally disorganised "hierarchies", in that these elements are clearly combined in endless ways, exhibiting a great deal of variation

in the overall arrangements. The alleged spatial model seems to have been defined on the basis of external causes (i.e., the privacy requirement) rather using physical evidence. In other words, the main argument held by the above studies seems to be conceived on the basis of general assumptions, such as the Islamic need for family privacy pre-supposing therefore similarities between cases, and as a result run into difficulties as soon as one attempts to account for differences that exist in the configurations of the towns. For example, both towns of Guemar and Algiers display dead-ends in their street configurations, yet they also show morphological differences in their grid structure, such that one is more regular and less distorted than the other. Similarly, the street network of Sale with many streets meeting at right angles, appears more regular than for example Fez. This by itself shows the lack of precision which characterizes this spatial model, and as such casts doubts as to the interpretations of the structure of Arab towns generated on its basis.

THE CENTRALITY OF KEY TOWN FACILITIES:

The other element that is widely recognized as a key characteristic of the physical structure of Arab towns is the central location of the great mosque in the midst of the market streets. For example, Marcais comments that the great mosque in Islamic cities, where the Friday prayer is celebrated, is generally located in the centre of the city, on the main thoroughfare which traverses the city (Marcais G., 1945, p. 527). This observation is also made by Planhol when he writes:

"The Muslim town obeys a number of well-defined general rules... from the pre-eminence of religious functions in the city derives

the central position of the chief mosque. It is in the heart of the whole complex... In its immediate neighbourhood are found the bazaar, a commercial district, with its suqs" (Planhol X., 1957, p. 9).

According to Balbas, the central part of the city, which is busy and animated, is occupied by the great mosque and most of the markets (Balbas T., 1942, p. 26); While Grunebaum also commenting about the central position of the great mosque, writes:

"The full fledged Muslim town has two focal points, the Friday mosque and the market. The Friday mosque, as a spiritual centre, is appropriately placed along the main thoroughfare or, where the plan of the town permits, at the rectangular crossing of two main thoroughfares" (Grunebaum G. E. V., 1955, p. 145).

On the other hand, the importance of religion is, according to Elisseeff, symbolized by the position of the great mosque which is, always located in the centre of the town and surrounded by a commercial complex (Elisseeff N., 1980, p. 91). To Burckhardt, the structure of the Islamic city is essentially determined by the central positioning of the market which links to the great trade routes, close by the main mosque (Burckhardt T., 1980, p. 166). Raymond on his part, identifies two aspects which arise from the fundamental character of the Arab city. The first concerns the high concentration of Islamic activity in the town centre. He maintains that the market and the great mosque played a decisive role in the structuring of urban centres. The second concerns the way in which the town activities have developed "by radiating outwards from the zone of the markets and the great mosque" (Raymond A., 1985, p. 10). Whilst, Massignon looks particularly at the relation between some trades and the great

mosque and suggests that the goldsmith's market ("saga") and exchange centre, are frequently located in the immediate vicinity of the main mosque, in the central region of the town (Massignon L., 1924, pp. 3-37). According to Lebon, most Islamic cities exhibited common features, with at the centre was the chief mosque, close by the most important suq or bazaars (Lebon J. H. G., 1971, p. 64). Similarly, Noe points out that "the main mosque is the religious, political and intellectual centre of the city.... The main roads lead from the gates to the central area where the major religious institution is located" (Noe S. V., 1980, p. 69).

Many more studies have acknowledged the central location of the great mosque in close proximity of the market area and the main town roads as a common feature to these towns. However, this point remains to be discussed, since a brief examination of the 12 town plans (see diagrams, fig. 1.2) already shows cases where the great mosque is neither positioned in the topographical centre of the town such as for instance in Susa, Kairwan, Sale, nor is always located within the market area such as in Sale, Guemar, Kairwan. This again illustrates well the ambiguity behind the procedure which continuously overlooks morphological differences in an attempt to fit an ideal model into reality.

At this stage, it seems reasonable to suggest that there are certain hazards of method underlying the above studies that have examined the spatial structure of Arab towns. The fundamental problem which has emerged is two-fold: first, there seems to be a conceptual difficulty in relating a general theory to specific cases in the definition of grid structures to allow systematic morphological

cross-comparisons; second there seems to be a clear difficulty in the attempt to relate urban form to socio-cultural factors. Moreover, the arguments presented by past studies fail to explain either similarities or differences between individual cases.

SUMMARY OF CHAPTER ONE:

This chapter examined the main issues relating to the definition of the physical structure of Arab towns, using the available body of literature. By this, the present chapter aimed to identify some theoretical concepts underlying the main approaches adopted in the study of the physical form of Arab towns and has concluded that firstly, these studies in their attempt to describe the physical form of Arab towns have sought external factors to acknowledge the existence of a prototypical urban structure, rather than focussing first on the study of the urban form itself; secondly central to the problem encountered in these studies is the double difficulty in defining how the different levels of order of the grid structure of Arab towns relate to each other to achieve a whole; and in relating social or cultural factors to the physical form of these systems.

CHAPTER TWO: CHARACTER OF FORTIFIED TOWNS OF NORTH AFRICA: LOCATION AND HISTORY NOTES

INTRODUCTION:

Chapter Two presents the 12 fortified towns in North Africa considered in this study in more details. The main intention here is to describe the towns individually both physically and spatially, and also to provide some general information for each of the towns concerning the historical background, the geographical setting (i.e. climate and site) and the dominant function in the course of time (i.e. capital, merchant, sea or desert port, religious holy centre, or military stronghold). The ground plans and various survey material are examined and some early travellers' accounts (19th century) and descriptions of urban scenes have been inserted whenever appropriate. Along with this presentation, a commentary will be maintained and developed on the themes discussed in the previous chapter. This chapter ends up by examining, in the light of the descriptive material, the main issues and claims brought forward by past studies. By this, it aims to point out to some aspects of the limitations of the approaches used in the description of the traditional urban forms, and therefore demonstrate that the questions relating to the morphological and spatial nature of these towns remain open. The presentation of the towns includes an initial commentary on some of the morphological differences that exist between the towns under consideration, and opens up a discussion about the problem of architectural description as faced by past studies on urban forms.

DATA GATHERING:

For the purpose of the present study, the cartographic material is of major importance as only maps convey clearly the way in which buildings are arranged on the ground. The cartographic material relating to the towns of interest is fairly limited, although some of the most important cases are documented at some early stage before 1900. In general, the cartographic record of this type of towns does not begin until relatively late: there is no true plan of these towns before the 19th century.

This study uses old maps established prior to any major urban transformations such as openings of new boulevards, creation of large open spaces which began to take place during the colonial administration. Along with this first requirement, the amount of detail and accuracy of information shown on the map, was also a major concern in the selection of these documents. The 12 selected base maps correspond to the most detailed documents established before urban transformation. Whenever there is doubt concerning for instance, a connection of two alleys due to a misrepresentation of an existing covered passageway; or the exact delimitation of the peripheral streets due to an approximate knowledge of the site of the town walls, destroyed in some cases before even the establishment of a map, the base map has been updated on the basis of the cross-examination of various maps and aerial photographs from different sources.

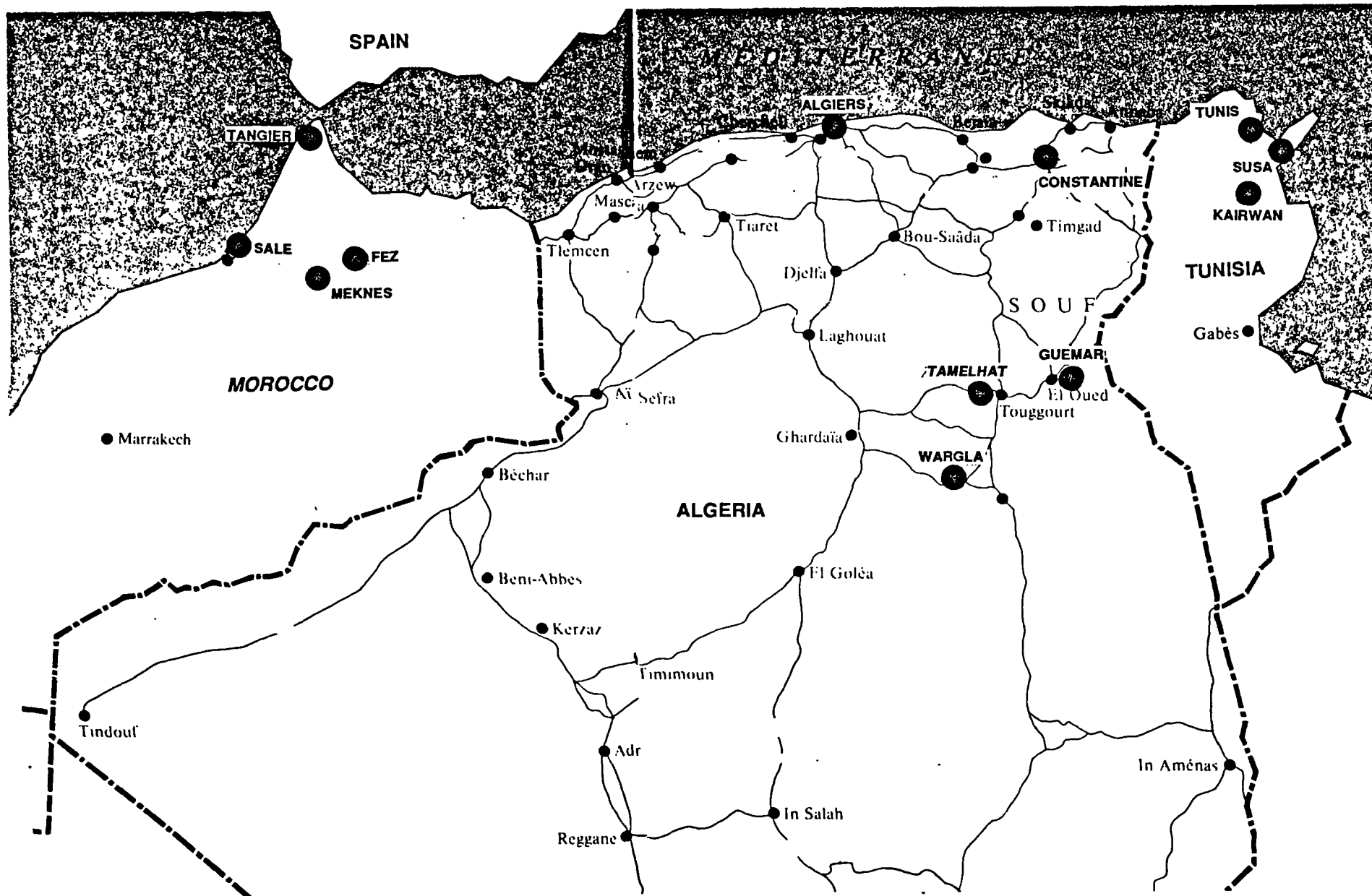


FIG. 2.1: LOCATION MAP

Many difficulties have been encountered in the data gathering due to the fact that there is no available primary source. An intensive search has been undertaken in various institutions such as libraries, the "Archives de la guerre" (Paris), Cartographic institutes (Algiers and Paris), and local Municipalities. In addition, field work has been conducted whenever possible and some maps have been collected and updated on site. For the precise source of the maps used in this study, the reader is referred to Appendix1.

THE TOWN OF TUNIS WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Tunis, the capital of Tunisia and one of its largest ports, is built on the side of a narrow strip of land which separates two large salt lakes. It is linked to the Mediterranean sea by the canal of Tunis which crosses one of the lakes on about 5 miles long. Tunis is located at about 90 miles north of Susa and 104 miles north-east of Kairwan (see Location map, fig. 2.1). This advantageous position, sufficiently near the sea, gives rapid connection with the European coasts. The climate is moderate (Mediterranean) with temperatures varying from 12 to 30 degrees centigrade, with a mean of 18 degrees centigrade (Geographical Handbook Series, 1945, p. 425). The total number of people residing in the old city is about 70.000 (Thurston H.M 1973, p. 124), but in 1936, the total population was estimated at 219.578 people (Geographical Handbook Series, 1945, p. 252).

THE COURSE OF TIME AND HISTORY NOTES:

The town of Tunis goes back to the Punic times, if not beyond. The Phoenician "Thines" or "Thounes" existed before the foundation of Carthage, yet was for long annexed and overshadowed by its rival; and it was only much later that Tunis became a city of the first rank. It was of no particular importance during the Roman, Vandal and Byzantine periods. With the Muslim conquest in the 7th century, Tunis gained importance and was soon to become a rival to Kairwan and Cairo (i.e., Thurston H., 1973, p. 128).

During the 8th and 9th centuries, Tunis saw the beginning of the development of the commercial possibilities, but remained particularly renowned as a centre of legal and religious teaching, partly due to the construction of the great mosque in 732 by the "Umayyad" (*) rulers. Tunis was the centre of opposition and resistance to the central authority exercised from Kairwan, and in 894 A.D., the "Aghlabite" rulers, in order to put an end to the rebellion, left Kairwan to Tunis which for the first time became capital of the country but only for a short time. In the 10th century, Tunis saw a period of great prosperity under the "Zirite" rulers until the invasion of "Beni-Hillal" from Egypt in the middle of the 11th century. Tunis was neglected by the "Fatimides", but their "Sanhajji" successors did a great deal to promote its prosperity, and undertook

(*) "Umayyad" and all the following Aghlabite, Fatimide, Zirite, Sanhadji, Hafsite, Saadian, Husainid, Merinid which will be referred to, correspond to names of dynasties which ruled in turn in various places of the Islamic Empire.

the construction of numerous public buildings, among them the citadel.

The town enjoyed continuing affluence between the 13th and the 16th centuries under the "Hafside" dynasty who made Tunis their capital for three and a half centuries. The first century of the Hafside rule saw the erection of many mosques and schools and colleges of very fine architecture, and by this time, Tunis was considered to have surpassed Cairo not only in wealth and importance but also as a centre of learning (i.e., Brunschvig R., 1942; Thurston H., 1973, p. 129). Religious sciences flourished there and Tunis saw a marked increase in the number of lawyers, scholars and students, and also a marked revival in building activity. With the decline of the Hafsides, Tunis became an easy target to the Turkish corsairs, who took it by surprise in 1534.

After other attacks by the Saadians from Morocco in 1569, and later by Don John of Austria (the Viceroy of Naples and Sicily), Tunis was taken by the Turks who were to remain in power over a long period (ibid, p. 32). Under the Turkish administration, the town saw an architectural revival with the restoration of many quarters, the extension of several markets, and the abduction of water conduits to various points of the city (ibid, p. 32). The decadence of the Husainid dynasty of the Turkish administration, led in the late 19th century to France assuming a protectorate of Tunisia. The French administration carried out later some urban transformations, although an attempt has been made to preserve its oriental character. A large number of public buildings were used for other than their original purposes, but

the general appearance of the city was kept to what it was in the past. After the independence (1956), Tunis remained the seat of the government, and large urban developments and new districts began to take place outside the walls of the old city.

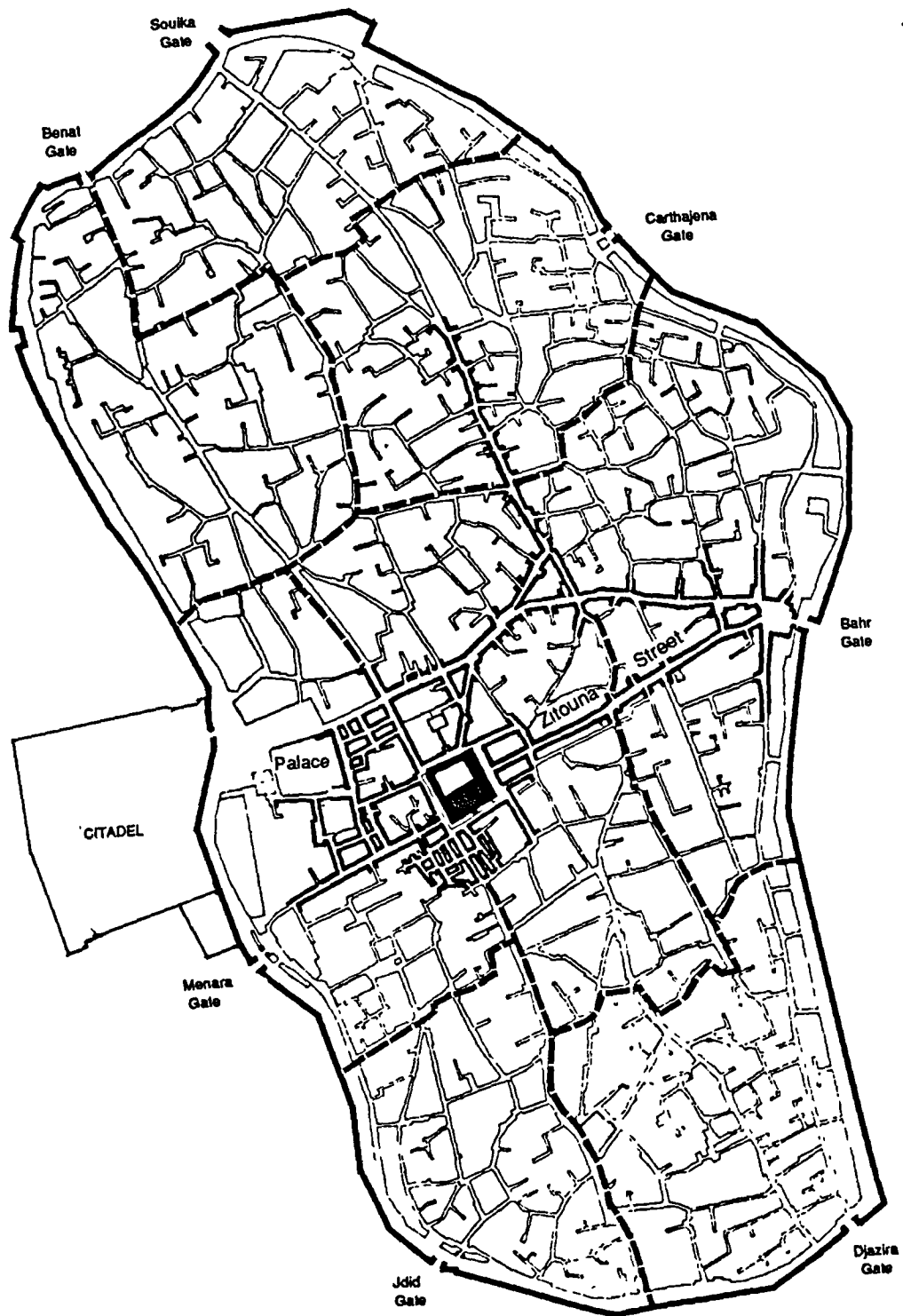
CHARACTER OF THE URBAN FABRIC:

The town of Tunis within the walls, built on a gently sloping ground, extends linearly to cover an "oval" area of approximately 103 hectares. The fortifications walls that surrounded the city have been demolished except for some gateways, and replaced by a ring of boulevards during the French occupation (Geographical Handbook Series, 1945, p. 250). The city of Tunis has retained its character and has changed little over the years. In the 19th century, Hessi-Wategg describes Tunis as:

"...proud even in its decay, the grand Moorish town looks majestic in a high degree... Hundreds of snow-white or dark green domes overlook the sea of houses gently sloping down towards El-Bahireh, and slender minarets tower over it all. "
(Hessi Wategg, 1882, p.14)

The town had formerly seven gateways (*), the most important one is "Bab El Bahr" (see Ground Plan, fig. 2.2). The ancient "Casbah" (the citadel), whose many of its buildings have been demolished to make way for barracks, is located at the highest point west of the city.

(*) The other gateways are, to the north-east "Bab Carthegenia" (or Bab-el-Khadra); to the north "Bab Souika"; and "Bab Menara" nearby the citadel to the west; and to the south "Bab Jdid"; and "Bab Djazira".



0 100 200 m

TUNIS

FIG. 2.2:



GROUND PLAN
Market street
Quarter boundaries
Town walls



This fortress contained at one time, the ancient palace of the Turkish rulers with a mosque, immense barracks for the accommodation of troops, and prisons for slaves. Immediately to the east of the Citadel is "Dar El Bey", the ruler's town palace, used at the present time as a museum. The ground plan of the city (see fig. 2.2) shows an irregular network of narrow streets and lanes, many of them dead-ends that constitute according to Hakim, 13% of the total street system length (Hakim B. S., 1986, p.168).

Hesse-wartegg commenting on the intricacy of the street network in Tunis writes:

"If a wanderer is without a guide, he is soon completely lost in this maze... He might enter dozens of well-paved streets, which all get gradually narrower and darker... In trying another street, we come upon a crowded bazaar, so full of life, screams and shouts, that we are glad to leave it again. After having marched for half an hour, only to return again to the same place, we take yet another direction." (Hesse-wartegg, 1882, pp. 10-11).

E'Nesbitt describing the market streets of Tunis shares the same view as he writes:

"...the first day it seems impossible to think of finding one's way through this intricate network, but gradually the main lines become clear and then it is easy enough to wander in and out at will with the certainty that confusion, or even total loss of bearings means nothing worse than another turn or two..." (E'Nesbitt F., 1900, p.139,156)

A casual examination of the ground plan and the aerial view (see fig. 2.3) shows indeed, an extremely dense fabric which is only

punctuated by a few public squares, the largest ones being located close to the periphery and in proximity of the Citadel and some town gates (i.e. El Bahr gate, Carthegina, Menara, see map, fig. 2.2). The central part of the city where the great mosque is located corresponds to the main trading section. It presents a distinct configuration with very small blocks and a more regular street pattern. The central area is linked to the eastern gate (Bab el Bahr) almost directly through a market street. Another fairly straight street links the western gate "Bab Menara", to the great mosque. The ground plan shows streets that are visually dominant and more regular, and which run from the great mosque across the town in different directions. They inter-link to form a kind of a "super-structure", dividing the urban fabric into sub-areas. The intersections of these streets at the gate "Bab el Bahr" is marked by a widening of the street. The street order in the area immediately north of the gateway "Bab el Bahr" appears more broken up and the blocks much smaller in size.

The markets are labyrinthine, whitewashed tunnel-like streets lit by little holes at regular intervals in the roofs, and with rows of small alcoves in the walls used as shops. The most important markets are "Suq El Attarin" (scent and perfumes) and "Suq El Blaghja " (shoes) immediately north of the great mosque; "Suq El Trouk" (cloth and linen) and "Suq Sekkajine" (saddle makers and leather goods) west of the mosque; "Sup El Berka" (goldsmiths and jewellers); and "Sup Ensa" (women's market). E'Nesbitt gives a detailed description of the various suqs, and the atmosphere which reigns in them (E'Nesbitt F., 1900, pp. 145-153). He writes:

"There are no such suqs in all the near East. The long vaulted halls, lighted only by rays of sunshine falling through square holes in the roof, are as fine as in Constantinople, and in addition, are full of life and colour... Each of the trades has its own suq, and each suq its peculiar character.... The "Suq el Trouk" (cloth and linen) is very formal, but decidedly the most distinguished of all... Rows of square cells on either side, dark yet glowing with colour, are packed with piles of silk and embroideries. The "Suq el Attarin" is the aristocratic quarter ... [and] the whole bazaar is full of perfume... The "Suq El Blaghjia" (shoe bazaar) is quite different. The street is narrow... the roof is of wood, the shops are a trifle wider and hold one or two men who are ceaselessly at work... One bazaar is full of compounds of dates and figs, dried fruits and grain. Another small street is given up to the sieve-makers..." (Ibid, pp. 145-153).

The great mosque known as "Djema' Ez Zitouna", a 9th century building, also an university for Islamic studies adjoins several religious schools. The town contains a large number of mosques, religious lodges and colleges, something like 86 mosques, 38 lodges and 18 colleges (Hakim B., 1986, pp. 76-78). The town of Tunis was technically divided up into 9 quarters (*) of different sizes (Hakim B.S., 1986, p. 121). The "Andalus" quarter is occupied by Muslim settlers who returned from Spain; "Hara" quarter corresponds to the Jewish district; "Francis" quarter was mainly inhabited by Christians. However, the examination of the ground plan indicates no distinct morphological boundaries separating these quarters. There are also

(*) The quarters of Tunis which have been approximatively defined by Hakim B.S., 1986, are locally termed "Tourbet El-Bey" (Andalusians), "Sabbaghin", "Beylical" (Turks), "Souk El-Blat", "Azzafine", "Frankish" (Christians), "Hara" (Jews), "Houmat Achour" and "Sidi Mehriz" (see map, fig. 2.4).

no apparent morphological differences in the configurations of the quarters (see fig. 2.2).

THE TOWN OF ALGIERS WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

The "Casbah"(*), the old city of Algiers, is situated on the Mediterranean coast, at equal distance from the strait of Gibraltar and Sicily. The old city is deployed on high ground, sloping down and overlooking the Bay of Algiers. It is bordered by deep ravines to the north and south, which made the city a natural fortress dominating the hinterland and the sea, as well as an attractive port of call. Seen from the sea, Bodley describes it as follows:

"... first impressions of Algiers, rising out of the Mediterranean sea like a white bubble in a sea of sapphire will be best [the visitor] will have of this once Turkish city... The sight of the Arab quarter, piling itself up in a pyramid of white and blue roofs above the European houses... is a vision of delight" (Bodley R.V.C., 1900, p. 167).

* The name of the Casbah has been adopted since the French occupation to designate the old city of Algiers. In fact, the name of Casbah refers only to the citadel built in 1516 during the Turkish administration.

The climate of Algiers is moderate with average temperatures ranging from 8 degrees centigrade in winter to 27 degrees in summer. The population of the city varied substantially over the years. For example, according to Dan, the population was estimated at 100.000 in 1634 (Dan P., 1637, pp. 94-138); while Venture de Paradis put it at only 50.000 at the end of the 18th century (Venture de Paradis, 1898*). The population of the city was also very mixed; there were Turks, Jews, Andalusians, Kabyles, Saharans from Biskra and the Mزاب towns and Europeans.

THE COURSE OF TIME AND HISTORY NOTES:

The origins of the old city of Algiers remain obscure. The discovery of Punic coins on the site suggests that the site was known to the Phoenicians under the name of "Ikosim", the sea-gull islands (Contineau J. & Leschi L., 1941, pp. 262-277). After the decline of Carthage (146 B.C.), the settlement became part of the kingdom of Mauritania until its fall to the Romans in 40 B.C. The Roman "Icosium" on the mainland was not an important settlement, although it was the seat of a bishopric. From the 4th to the 10th century A.D., "Icosium" saw a period of war and trouble following the invasions by the Vandals and the Byzantines. The town was almost totally destroyed and deserted. It was rebuilt in the 10th century by the Zirides. Its name became then "El Djazair" (the islands) due to the rocky islands facing the sea. In the 14th century, the town passed

* According to the Comedor, the population of Algiers was estimated at 20.000 people in 1830, 35.000 in 1841 and 87.045 in 1966 (Comedor, 1974, p.19).

under the administration of the "Tha'aliba" tribe of the Mitidja (the plain of Algiers) and gradually became independent, until the arrival of the Turkish corsairs in the 15th century, following constant threats by the Spaniards which led the inhabitants of Algiers to seek protection from the Turkish pirates (ibid, p. 5). The town became then a stronghold and an operating base for privateering, which became a profitable business and an important income source during the Turkish era. The pirates were not only pillagers but also soldiers of the Holy war against crusaders (ibid, p. 6).

During the Turkish administration which lasted over three centuries, Algiers grew into an important merchant coastal town; it became the capital of Algeria and has remained so ever since. The town saw an architectural revival and became the scene of numerous urban developments. In the lower part of the city, the Turks built a palace (Jenina) and luxurious residences for Turkish dignitaries and wealthy privateers. Many mosques, schools and public baths were also erected, together with a large number of barracks (8 according to the Comedor document, 1974, p. 8) which were virtually all demolished later during the French occupation. Often, such piracy provoked reprisals from European countries (1*). Treaties with these latter resulted in a decline of the economy of the city. Natural disasters and epidemic diseases (2*) accelerated the decadence of the city and

(1*) The town was bombarded by the Spaniards in 1567, 1775 and 1783; the Danes in 1770; the French in 1661, 1665, 1682, 1683, 1688 and the English in 1662, 1665, 1672. Later, in 1824, an attack was launched jointly by the Spaniards, the French and the British.

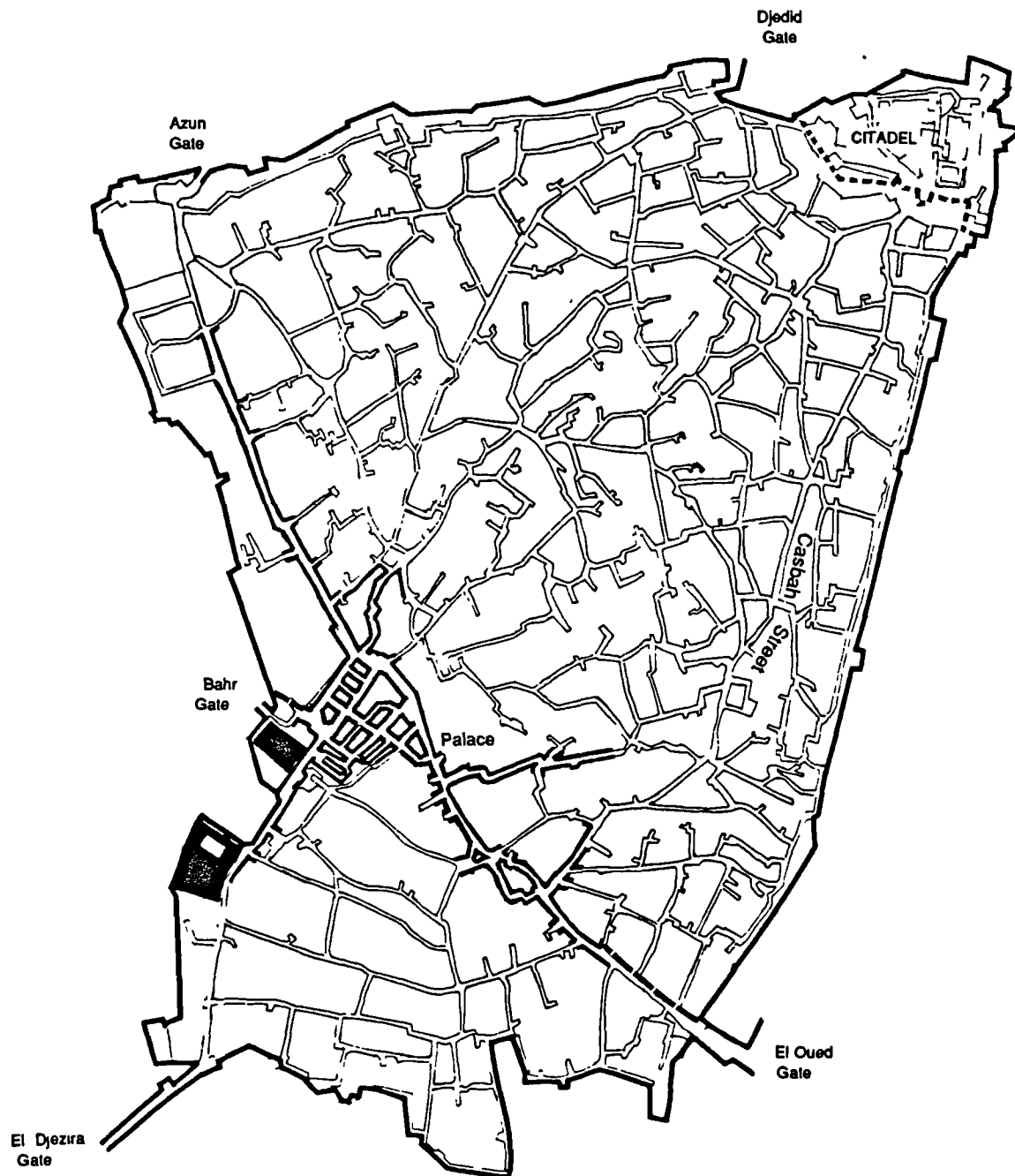
(2*) In 1716, an earthquake destroyed much of the city's buildings; in 1787, Algiers lost more than 17.000 lives due to epidemic diseases; and in 1817, the death rate was about 500 people per day.

the weakening of the Turkish power, to the point that the subsequent French invasion in 1830 met no resistance. During the French colonization, the town underwent dramatic transformations and large scale demolition schemes which hit mainly the lower part of the town near the port. However, the following description and ensuing analysis of the town concerns only the urban fabric of Algiers before the French interventions.

CHARACTER OF THE URBAN FABRIC:


The city of Algiers within the walls covers a triangular area of about 45 hectares (Raymond A., 1986, p.xi), rising steeply from the coast and dominated by the citadel which occupies the most strategic point of the site and offers a panoramic view over the bay. The fortress was separated from the rest of the city by a wall and contained palaces, residences and barracks for the Turkish governors and their soldiers. The rulers of Algiers occupied originally the palace "Jenina" in the lower part of the city, half way along the main commercial street (see map, fig. 2.4). The City was surrounded by high defensive walls, reinforced by a moat of 8 metres deep and 11 wide, dug around the walls, and several bastions and watch-towers. Access to the city was gained through five gateways, "Bab El-oued" to the north, "Bab Azoun" and "Bab Djedid" to the northern side of the walls and "Bab Ed-Djira" and "Bab El-Bahar" on the sea side of the town.

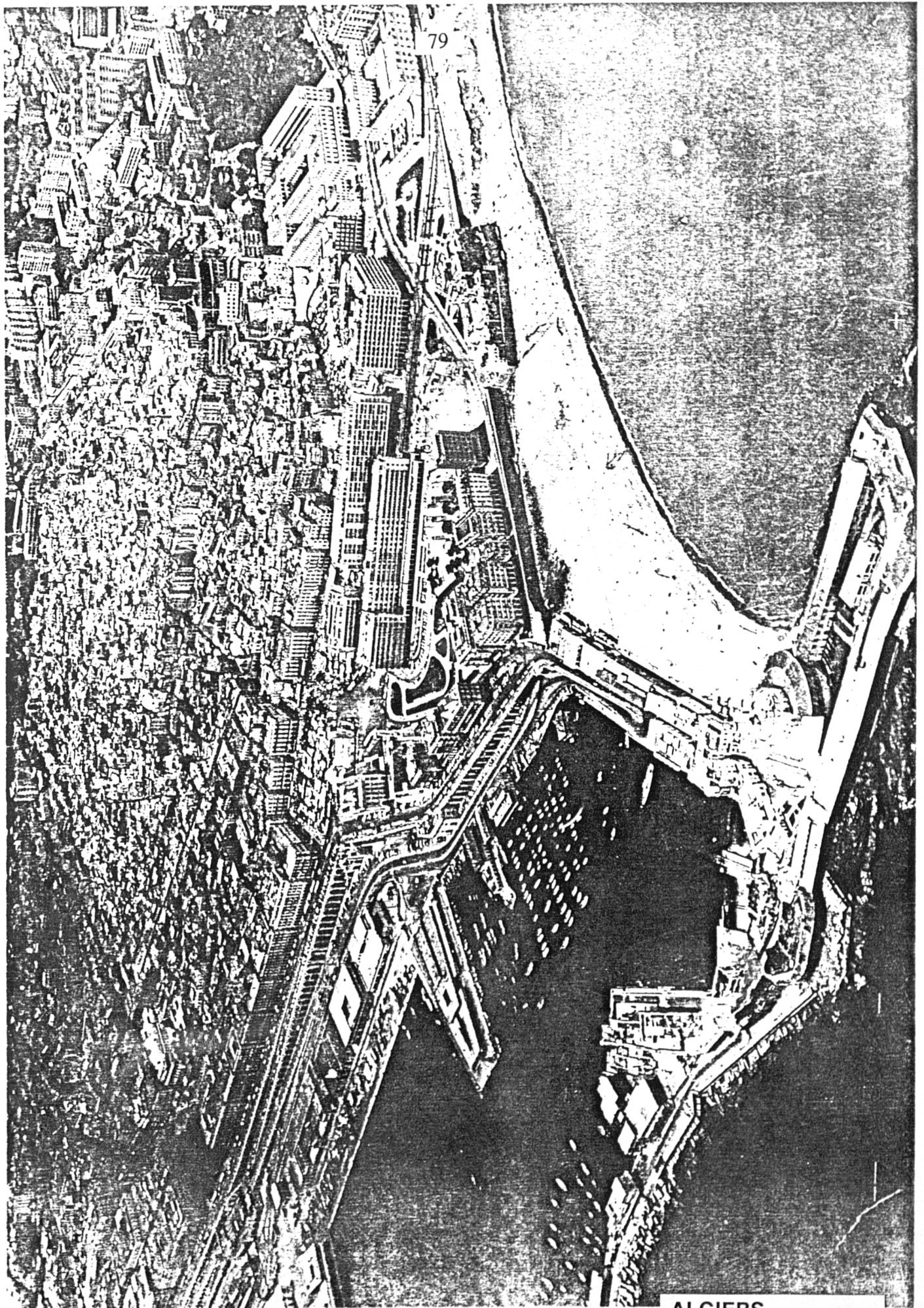
A general view of the city (see fig. 2.5) shows a compact townscape of whitewashed terraced houses falling away from the citadel. The



ALGIERS

FIG. 2.4: GROUND PLAN


 Market street
 Quarter boundaries
 Town walls



ALGIERS

FIG. 2.5: AERIAL VIEW

ground plan in Figure 2.4 shows a dense fabric of irregular blocks, and a maze-like network of narrow streets and dead-ends. In some places, especially in the upper part of the city, these alleys take the form of very steep ramp and stairways. Gaskell describing the streets of Algiers, writes:

"A walk or rather a climb to the quarter inhabited by the native population is a *terra incognita* where all is new and strange... Many [streets] are ascended by steps, very steep and apparently interminable... As we proceed we go through vaulted passages with houses above them built across the road... In the architecture of the old town each storey projects beyond that below it, the part which advances being sustained by inclined props resting against that wall so that the upper stories almost touch those opposite to them... For the uninitiated, the narrow streets of the old Arab town are so mysterious and complicated that the warning of the poet *lasciate ogm speranza, voi, chentrate* might be inscribed at the entrance of the labyrinth. It is almost impossible for the stranger not to lose himself. Having advanced a few steps, he sees before him three or four openings into small lanes offered for his choice; he enters one, but soon finds that is again crossed like the meshes of a net" (Gaskell G., 1875, p. 4).

The visual inspection of the map shows at least two differentiated areas in terms of the structure of their grid, the lower part of the city presenting a relatively different configuration with more regular street network and blocks of fairly similar size with fewer dead-ends, and the upper part with more irregular street pattern. The lower part constituted the residential quarter of the Turkish elite and wealthy families of the city.

The configuration of the main market area is also quite distinct from the plan and is constituted by a cluster of very small blocks. 'The

market area of the city, organised according to the type of trade and craft, also extends along the main streets which run from the gate "Bab Azoun" northwards towards the gate "Bab El-Oued", and westwards towards the gate "Bab Dzira". These streets are lined up with continuous rows of small shops and workshops and are the centre of intensive commercial activities.

The great mosque is located on the periphery in close proximity of the port, at the end of the market street and at almost equal distance from the gates "Bab Al-Bahar" and "Bab Ed-Dzira". The city contains also a large number of smaller mosques and schools (200 according to the Comedor document, 1974, p. 8) scattered all over the fabric. In addition to these religious and educational institutions, there were a number of other public facilities variously located over the surface of the town, which included about 150 public fountains, several public baths and public bakeries, cafes and founduqs, a sort of inn and warehouse at the same time.

As mentioned earlier, the city was divided up into two main parts, the "lower city" more recent accommodating the commercial activities and the more significant buildings (palaces and mosques, arsenal), and inhabited by the wealthy Turkish families; and the "upper city" of a more residential character with smaller and more modest houses (ibid, p. 7). During the French occupation, a large part of the lower "Casbah" was demolished, except for a few mosques and palaces.

THE TOWN OF SALE WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Sale is a town in Morocco on the Atlantic coast (see Location map, fig. 2.1, p.64). It occupies a flat ground, situated on the northern bank of the river "Bu-Ragrag", at the point where the river enters the sea. Instead, the western side of the town is used as a burial ground, and contact with the sea is established through the river. The city of Sale never had a citadel, and for its defense, Sale had to rely on the citadel of its twin city Rabat located on the opposite bank. Sale within the walls has a population of about 20.000 inhabitants (Naciri M., 1963, p. 18).

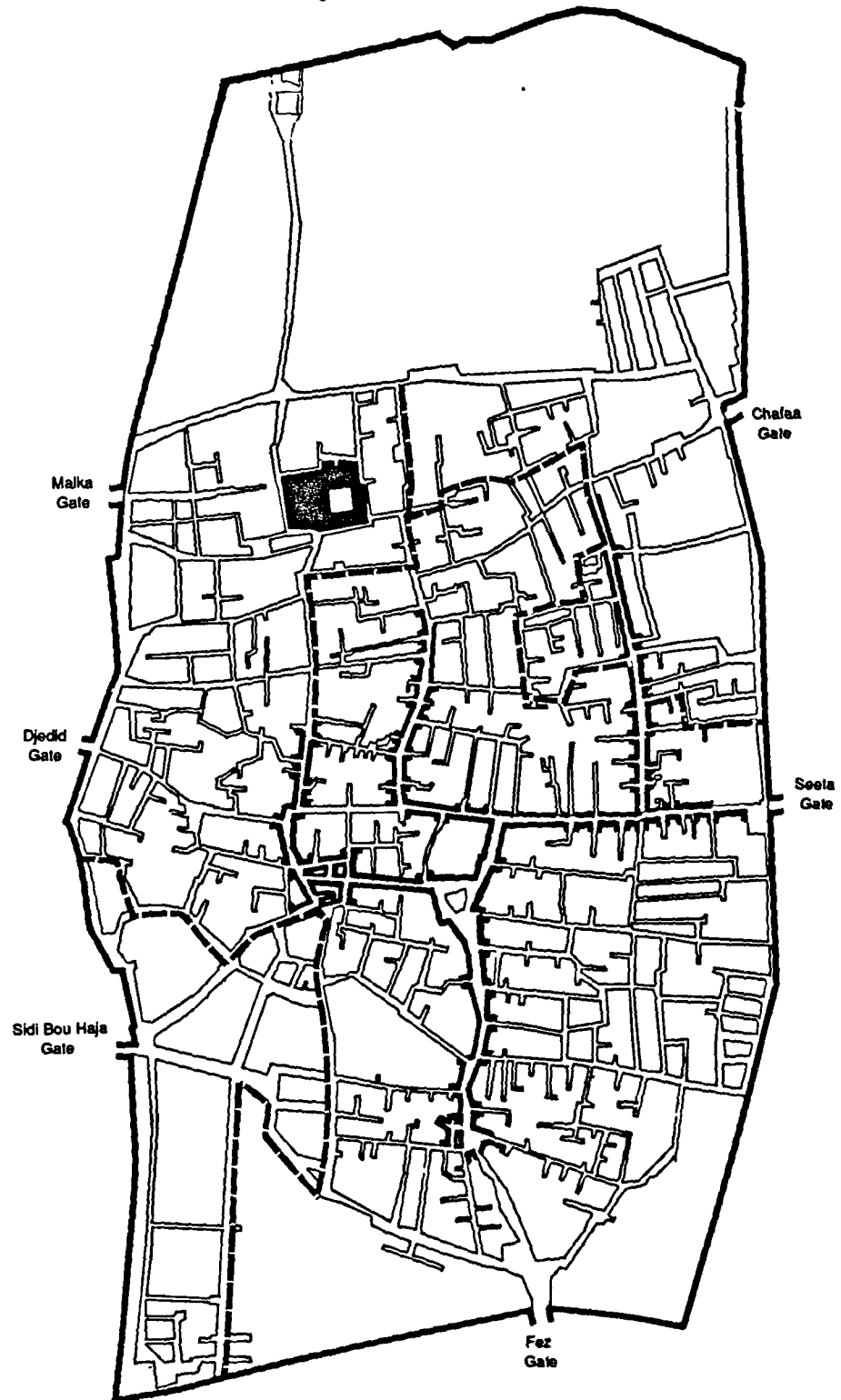
THE COURSE OF TIME AND HISTORY NOTES:

The information concerning the origin of foundation of Sale remains fragmentary. According to Basset, Sale dates from the Punic and the Roman times, but was not exactly on the same site as the present time Sale stands (Al-Idrissi, trans. Basset H., 1898, pp. 83-84). The antiquity of the town can be seen in the remainings of the Roman settlement in the nearby sites. It was not until year 950 that Sale was first mentioned in Arabic source by H. Al Baghdadi. During the 11th century, the town saw rapid expansion and the construction of numerous palaces to accommodate rich families from Cordoba (Spain). In the middle of the 12th century and according to Al-Idrissi "Sale was a fine and strong town with rich bazaars, a harbour frequented by Spanish ships..." (Al-Idrissi, trans. Basset H., 1898, p. 83). In 1251,

the town passed under the "Marinid" dynasty; and in 1260 it was taken by surprise but only for a short time by Spanish forces. After this attack, the town was fortified by a wall on the river side, and a naval arsenal was built on the south-western side. The religious college of Sale dates from this period. Sale was also a strong-hold for piracy, and a principal commercial port on the Atlantic coast, used until the end of the 18th century as a rally point by travellers and traders from Europe on their way to Fez. Through the centuries, the town of Sale distinguished itself from its twin city Rabat by its constant prosperity.

CHARACTER OF THE URBAN FABRIC:

The town of Sale within the walls covers a rectangular area of about 90 hectares including a large cemetery. The town turns completely its back on the sea and opens more on to the river side. It is surrounded by high walls and access to it is gained via 9 gateways (see Ground Plan, fig. 2.6). The ground plan of the town in Figure 2.6 shows a dense fabric with blocks, many of which are of relatively small size and fairly regular shape. Compared to Algiers, the overall grid structure of Sale presents more regularity, with several streets meeting at right angles (see also Aerial view, fig. 2.7). The map shows one relatively wider street which runs from the southern gate to the central part of the town where the market square is located. The fairly regular grid structure seems to disintegrate to become more disorderly in the area immediately west of this main street, in the vicinity of "Djedid" and "Bouhaja" gates. The covered market of luxury goods lies at the junction of the streets linking the gateways



0 50 100 m

SALE

FIG. 2.6:

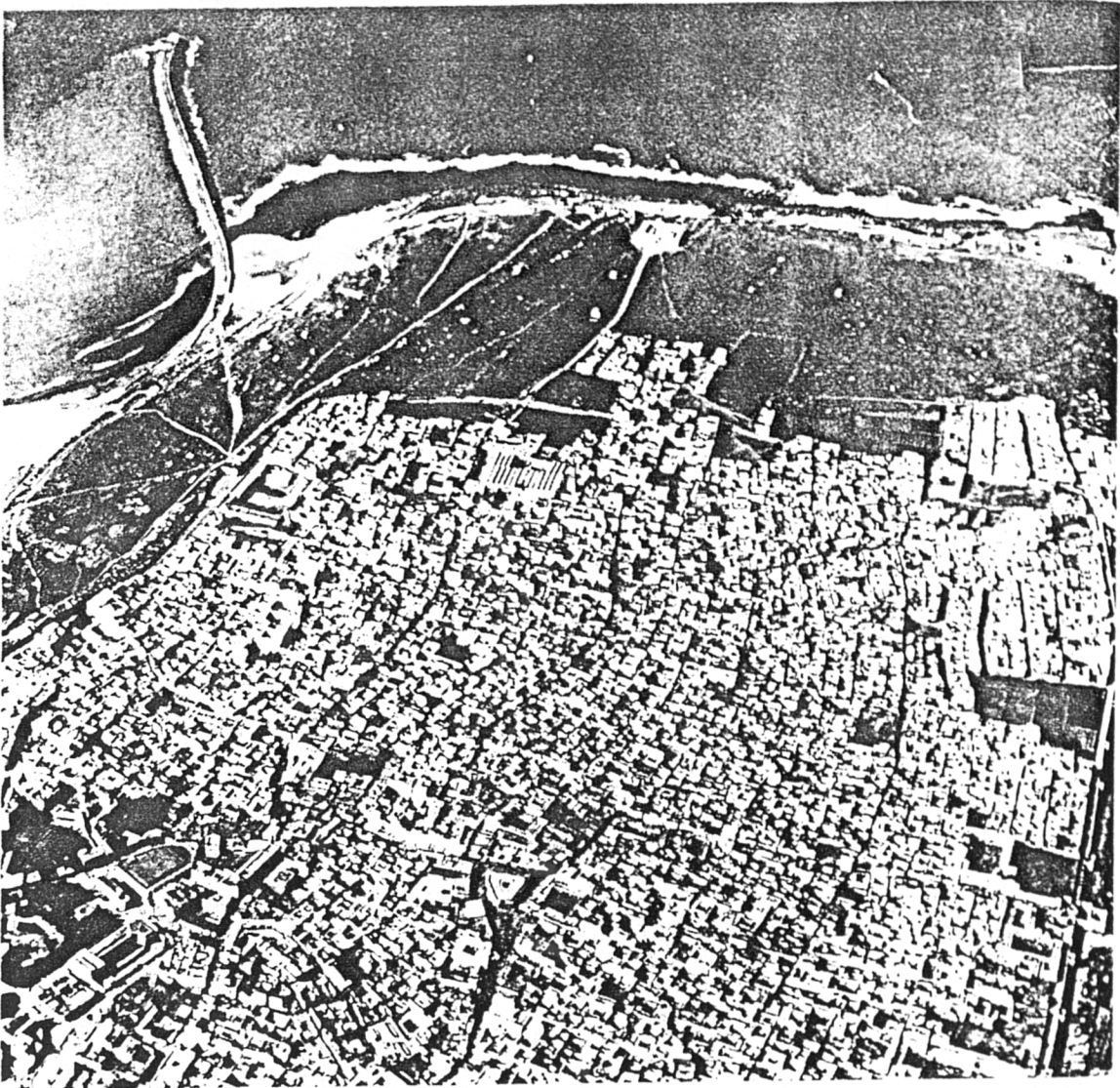


GROUND PLAN

Market street

Quarter boundaries

Town walls



SALE
FIG. 2.7: AERIAL VIEW

of "Bab Sebta", "Bab Bou Haja" and "Bab Fez" (see fig. 2.6). Commercial activities also develop along these streets. The street running from "Bab Sebta" intersects a small open square, known as "Suq El-Ghezel" (the wool market) which is surrounded by shops. Nearby this square lies another market termed as "Suq El Merzouk", reserved mainly for goldsmiths and matt makers. The most important market square, known as "Suq El-Kebir", lies at the junction of the streets linking to the gates "Bab Sebta" and "Bab Fez". This market place is also bordered by shops and boutiques. The town contains other specialized market streets developing along streets connecting to the main market place. The great mosque is very eccentrically located in the north-western part of the city, away from the market area.

Four different stages of growth of the town have been distinguished by Naciri, (Naciri M., 1963, pp. 18-31), but the limits between each of the phases, are not clearly visible in the physical configuration of the town (see fig. 2.6). The north-west part of the town is known as the "Bourgeois" quarter where many rich families originally from Cordoba (Spain) have settled. The Jewish quarter occupies the south-west corner of the town. The central quarter where the market streets are located, constitutes the oldest part of the city (ibid, pp. 18-31).

THE TOWN OF SUSA WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Susa, the ancient "Adrumetum" lies on the eastern Mediterranean coast of Tunisia. It is located at about 90 miles south of Tunis and 37 miles north-east of Kairwan (see Location Map, fig. 2.1, p. 64). The northern and southern edges of Susa are fringed by rocky shoals. From the sea, Broadrick describes the town as:

"The strand of Sousse shelves steeply from the sea and you turn back amid the white dust and the grey green olives to view the oblong walled town, its thick battered ramparts... It is medieval Europe that you are reminded of, the medieval Europe of the fairy-stories and histories, and of the glimpse you get of Villeneuve-Les-Avignon from across the Rhone [but] Sousse is a living thing not a museum-piece... such as Carcassone or Rothenberg" (Broadrick A.H., 1900, p.70).

The town has a Mediterranean climate, with temperatures ranging from 10 to 35 (Geographical Handbook Series, 1945, p. 259). The population of Susa has increased steadily to be evaluated in 1921 to 19,754 , and 28,465 in 1936 (ibid, p. 257).

THE COURSE OF TIME AND HISTORY NOTES:

Susa was the scene of many stirring events in the past. It was founded by the Phoenicians in the 9th century B.C. (ibid, p. 256). It is very ancient and existed before the Romans took over Tunisia and made it a Carthaginian trading post. The town became the capital of

the province of Byzacena and was very prosperous. In 430 A.D., the town was destroyed by the Vandals, but was re-built later and named Justinianopolis.

In 670, the town saw a series of attacks by the Muslim armies from the east, via Kairwan. It was conquered by the Muslims after defeating the Byzantine army. During the 8th century, the town passed under the administration of the "Caliphate of Baghdad"; and at the beginning of the 9th century, the "Aghlabites" restored the town and used it as a port of embarkation for the invasion of Sicily. Later, Susa became a haunt for pirates who raided the coasts of Italy, and in the 12th century, it was occupied for a short time by the Normans of Sicily (Leo Africanus, trans. Epaulard A., 1952, p. 390).

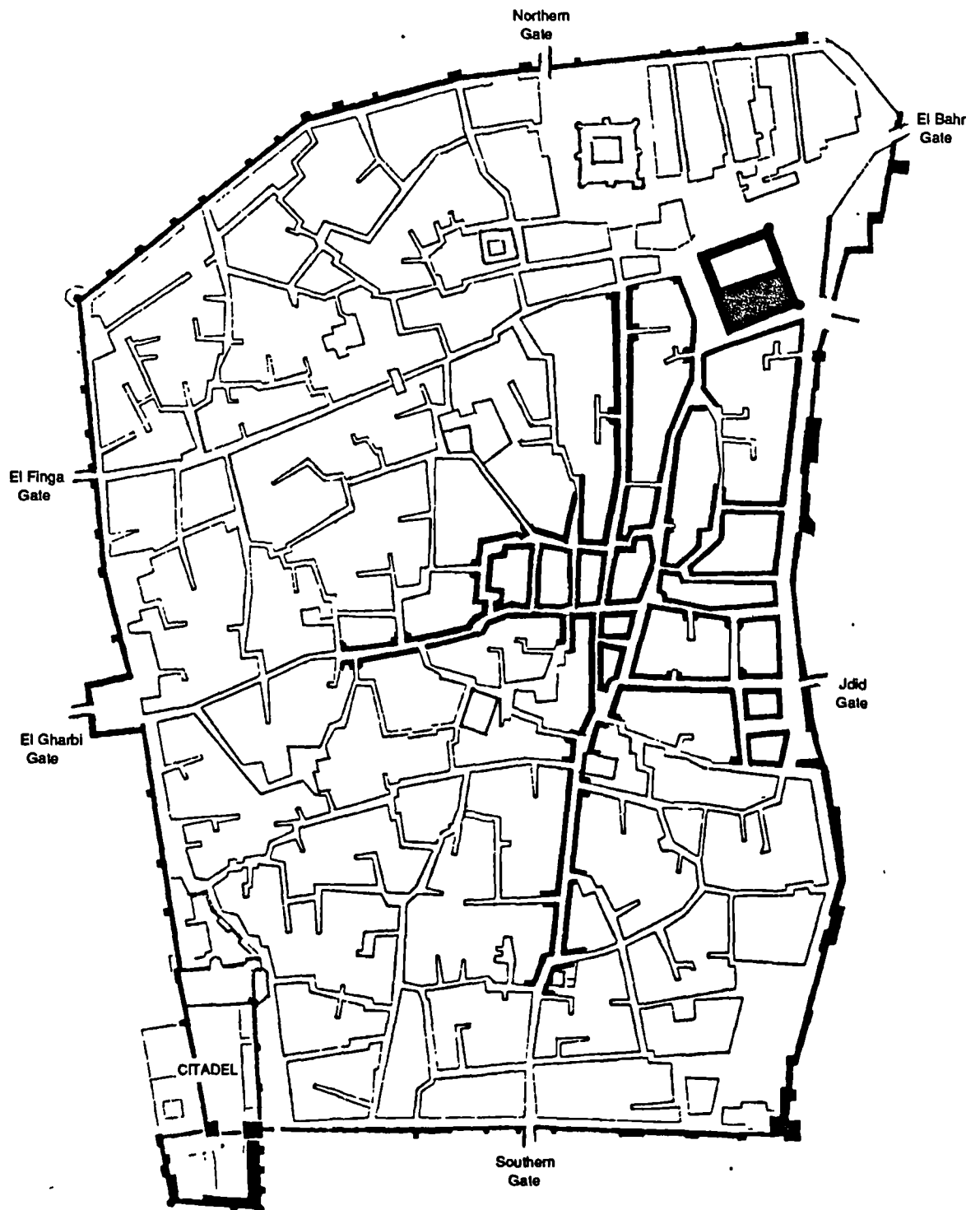
In 1537, the Spanish fleet bombarded the town which was then under the regency of the Bey of Tunis. The Turkish administration slowly lost control of Tunisia to the French; and in 1883 it became part of the French Protectorate. During the French occupation, Susa experienced a large influx of French people and became an important administrative centre as well as a regional market and a small port city. Since the independence, the town saw a rise in tourism, which constitutes at the present time one of the major income sources (i.e., Geographical Handbook Series, 1945, p. 258).

CHARACTER OF THE URBAN FABRIC:

The town of Susa is built on the slopes of a hill overlooking the harbour. It covers an area approximating a rectangle of about 40 hectares, sloping down gently widthwise towards the sea. This picturesque location rarely went unnoticed by visitors, and among them Graham and Ashbee who write:

" From the sea, its [Susa] aspect is remarkable, rising like a whitened pyramid from above the water's edge, and culminating as usual in the walls of the Casbah [the citadel] and the elevated watch-tower of the citadel... The view from the casbah is very extensive, and embraces an illimitable sweep of land and water..." (Graham & Ashbee, 1887, p. 61).

The town is fortified by thick defensive walls with several bastions and watch-towers. Recesses in the inner side of the eastern wall are used as shops and stores (Geographical Handbook Series, 1945, p. 257). At the south-eastern corner, the walls enlarge to enclose the citadel which is dominated by a tower used now as a lighthouse. Access to the town is gained through six gateways, the most important ones being "Bab-Jedid" and "Bab-Al-Bahr" gate of fine architecture described by Boddy as "most picturesque-deep moorish archways with covered ways leading to a second gate inside" (Boddy A.A., 1885, p. 147); and "Bab-Al-Gherbi" gate nearby the citadel at the hill-top (see Ground Plan, fig. 2.8). This latter constitutes the main entrance point for caravans and visitors coming from the hinterland of the city.



0 50 100 m

SUSA

FIG. 2.8:

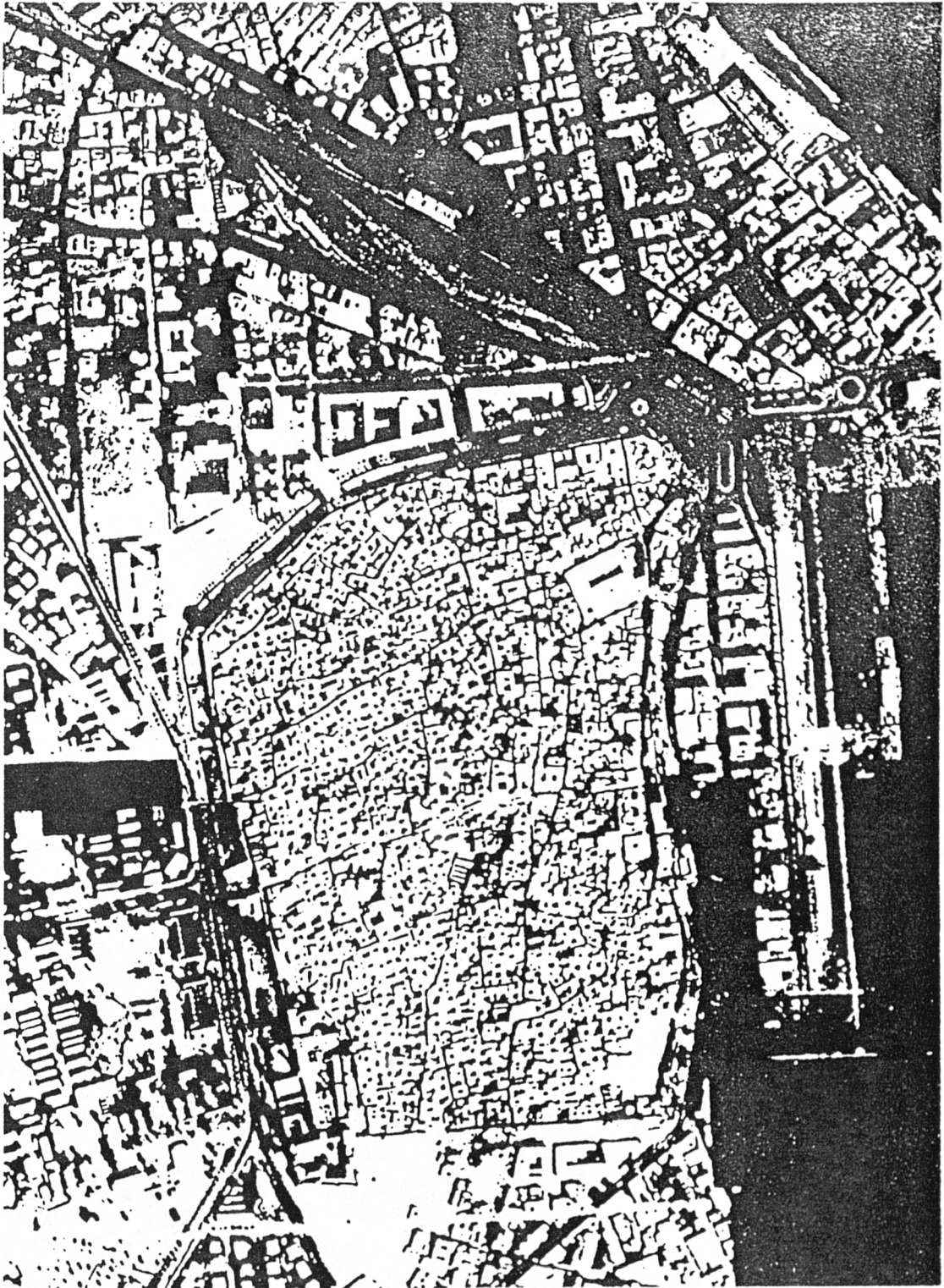
GROUND PLAN



Market street



Town walls



SUSA

FIG. 2.9: AERIAL VIEW

The ground plan of the city in Figure 2.8 and the aerial view (see fig. 2.9) show the irregular street pattern and the concentration of the main commercial facilities in the central part of the town. The streets many of which cul-de-sacs, are narrow often sharply angled and defining densely built blocks of various shapes. Hammerton in his description of Susa comments that:

"...If an invader gets inside the walls, he will never find his way to the centre. Narrow lanes twist and turn continuously, like the passages of a maze, with confusing cul-de-sacs branching off everywhere, so that an unwelcome visitor could be ambushed in no time. Even a welcomed one gets lost very easily..." (Hammerton J., 1973, p. 246).

The examination of the town plan shows that some streets present a more regular configuration than others. These tend to define longer routes which run from four town gates (i.e South. El Gharbi, El Finga and Djedid gates) forming a dominant structure which appears to link the great mosque and the market areas to the western and southern gates, and cut across the urban fabric defining then sub-areas. The street, which accommodates the metal-workers' quarter, runs from the "Bab Gherbi" gate towards the area of the "Er-rebaa" central market (see Ground Plan, fig. 2.8) which constitutes the heart of the trading quarter. The other fairly regular street runs northwards from the Southern gate, across the market area towards the "ribat" which is a large square building with a high watch-tower and seven bastions, built at the turn of the 7th century as a monastery for the warrior monks "who were charged of defending Islam against the incursions of the crusaders" (Thurston H., 1973, p. 247), but is used now as a religious school. The town encloses a considerable number

of mosques and religious lodges, the most important ones being the great mosque located at the north-eastern corner of the city, and the religious lodge "Zakkak" located nearby the "ribat" building. The great mosque is an ancient building, built in the 9th century, during the "Aghlabite" epoch (ibid, p. 247).

The ground plan shows a clear drift in centrality of the trading area towards the eastern edge of the town, with the goldsmiths and jewellers' shops located mainly in the smaller streets, north of the central market (known as "Er-rebaa"). The vaulted "Er-rebaa" market itself accommodates boutiques and workshops specialized in woven materials. In addition to this commercial nucleus, smaller commercial groupings variously located exist also in the more residential areas. There is no reference in the literature to the phases of growth of the town of Susa, nor to its division into distinct quarters, with the exception to the Jewish quarter mentioned by Boddy, without however giving its proper location (Boddy A.A., 1885, p. 148).

THE TOWN OF TANGIER WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Tangier, the ancient "Tingis", is situated on the Strait of Gibraltar in Morocco, at the point where the Atlantic coast begins (see Location Map, fig. 2.1, p. 64). The town overlooks the Bay of Tangier and is bound on the west by the citadel, built on high ground. The site enjoys a moderate climate with average temperatures ranging from 10 degrees centigrade in winter to 27 degrees centigrade in summer (Geographical Handbook Series, 1945). In 1872, the population of Tangier was estimated at 14.600 people (Leared, 1891, p. 21).

THE COURSE OF TIME: HISTORY NOTES

Throughout the centuries, Tangier has been subject to several influences. First, the site was known to and inhabited by the Phoenicians and then by the Carthaginians, Romans, Vandals, Byzantines and Visigoths (Stuart G.H., 1955, pp. 1-2). It was at the beginning of the 8th century (711 A.D) that Tangier was occupied by the Muslim warriors, which were to carry out from the neighbouring Ceuta, the first Muslim landing in Spain. During the period of the governors nominated by the Caliphs of the east, Tangier became the capital of Morocco. It was only until 949 that Tangier was annexed to the administration of the Umayyad "Caliphs" of Spain; and in 1077, Tangier was taken by the "Almoravids" (ibid, pp. 3-4). On the fall of the "Almoravid" dynasty, the town passed at once under the

"Almohads", during which it remained a flourishing town and a port which was much used on account of its proximity to Spain (ibid, p. 4).

In the 15th century, Tangier entered the grasp of European powers, in turn Spain, Portugal (1471-1661), and England (1661-1684; ibid, pp. 5-9). In 1684, Tangier was taken by "Moulay Ismail" who at once proceeded to rebuild the town which had been left in ruins by the English (Levi-Provencal E., 1957, p. 652; Stuart G.H., 1955, p. 9).

From the 19th century, the town was the residence of the representatives of foreign countries at the court of the sultans of Morocco. This role of diplomatic capital has given Tangier a character of its own; and in 1923, the town was proclaimed as an international zone and a duty-free port. During this period, the town prospered greatly and made a name as a centre of smuggling, money trade and slave traffic. Tangier became part of the State of Morocco in 1956 (ibid, pp. 10-13).

CHARACTER OF THE URBAN FABRIC:

The town of Tangier within the walls covers an approximately trapezium-shaped area of 20 hectares, with sides of about 300 and 700 metres on the land side and 600 and 400 on the sea side (see Ground Plan, fig. 2.10). The town is deployed on high ground sloping up progressively from the bay. The highest point and at the same time the most favourable one from a strategic point of view, is occupied by the citadel which includes, in addition to the government

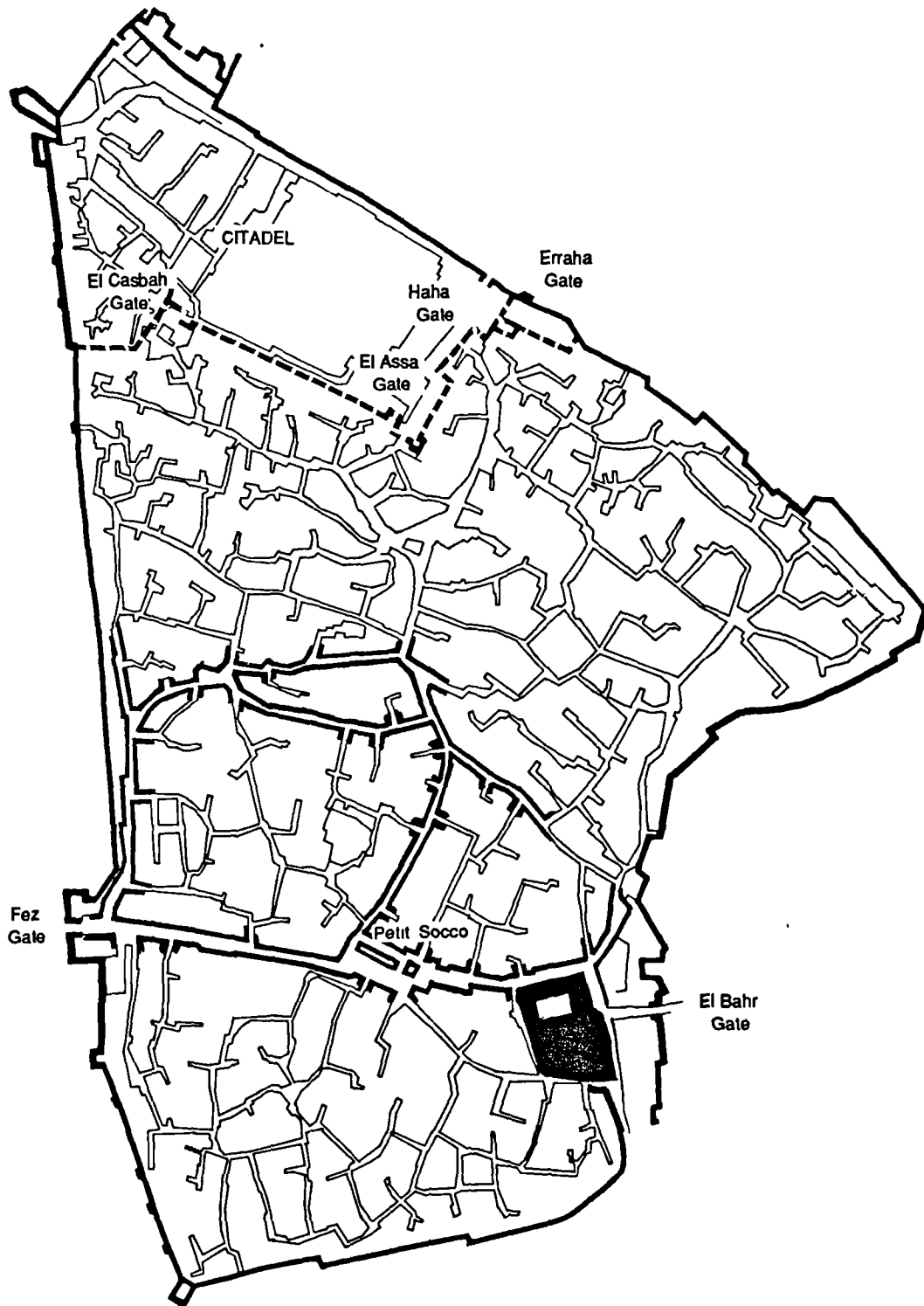
buildings, a residential district with whitewashed houses and a mosque (see Aerial View, fig. 2.11). The citadel is separated from the town by walls and has its own entrance gates. It was built during the reign of "Moulay Ismail" and was the residence quarter for the governors of the town for several centuries.

The town is surrounded by fortification walls and has five gateways, of which "Bab Fez" at the south-western wall, is the most important of all. The passage between the citadel and the rest of the town is controlled by two other gateways called "Bab Assa" and "Bab Haha". The plan of Tangier in Figure 2.10 shows that the streets and alleys which appear to intersect at more obtuse and open angles form a highly distorted grid. Leared describing the streets of Tangier, writes:

"As seen from the sea, the houses of Tangier appear to stand one above the other like steps. As might therefore be expected, many of streets are very steep, and all, with the exception of the main street, are mere winding lanes,... the principal street runs up the hill from the water side to the suq or market place, just outside the walls... It is difficult for a stranger to find his way through the maze of the smaller streets" (Leared, 1891, p. 21)

A relatively wider street which runs East West across the town links the gate "Fez" to both, the market place "Petit Socco" and the great mosque located by "El Bahr" gate. This mosque was, according to some sources, rebuilt on the site (*) of a Portuguese cathedral (Levi-Provencal E., 1957, p. 270). The map shows also a second fairly wide

(*) According to Levi-Provencal, the great mosque existed before the Portuguese occupation, during which time it was transformed into a church.



0 50 100 m

TANGIER

FIG. 2.10: GROUND PLAN



Market street
Town walls



TANGIER
FIG. 2.11: AERIAL VIEW

street running in the vicinity of the citadel. The weekly market is held outside the walls on a large open area in proximity of "Bab Fez". The second important mosque in the town known as "Aisauas" is located north from the "Petit Socco" place. Another street along which develop markets runs north from the market place in the direction of the citadel. These streets together with the outside market area and the "Petit Socco" market constitute the trading centre of the town. In addition to the main mosque which shows a clear urban de-centring, a number of mosques of lesser importance exist and are scattered all over the town. Similarly to the case of Susa, there is no reference in the literature to the division of Tangier into separate quarters, nor to its phases of growth.

THE TOWN OF CONSTANTINE WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Constantine lies 330 miles east of Algiers (see Location map, fig. 2.1). It is built on a rocky plateau sloping down in the form of a trapezoid bounded on three sides by deep ravines, and connected with the hinterland on the south-east only by a narrow isthmus. Gaskell describes Constantine as

"Grand and impressive is indeed the first view of Constantine, placed as by enchantment on its mighty pedestal of stone, in the midst of a vast mountain-bound panorama... queen of picturesque cities, on her rocky height, towering in pride of place, she overlooks all around..." (Gaskell G., 1875, p. 253).

The site of Constantine makes the town a natural fortress, with the citadel occupying the highest point at 2500 feet above sea level, surrounded on the north and west by ravines, at the bottom of which flows the Rummel river. The climate of Constantine is characterized by cold winters and hot summers, with temperatures falling below 0 degree centigrade and exceeding 30 degrees centigrade during the hottest months. In 1837, the population of the old city exceeded 25000 (Geographical Handbook Series, Vol II, 1944, p. 70).

THE COURSE OF TIME AND HISTORY NOTES:

The origins of Constantine are obscure, but the site must have been occupied at a very early period by an autochthonous population. There has been reference by classical texts to a town named "Cirta" on this place (ibid, pp. 72-73) which was the capital of the kings of Numidia and later became a Roman colony (ibid, p. 73). It was occupied by the Vandals (in 442 A.D.) and then by the Byzantines (533 A.D.) until the Muslim conquests of the 7th century (ibid, p. 73). Constantine became part of the provinces of Ifrikiya (Tunisia), which were ruled successively by the governors of Kairwan, the Aghlabids, the Fatimides, the Zirids who lost it to the Hillali invasion from Egypt. During the Almohad dynasty, the town experienced great prosperity (*).

(*) El-Bekri described Constantine as "a large and ancient town with a numerous population... It is inhabited by various families who were originally part of the Berber tribes established at Mila... It has rich bazaars and a prosperous trade." (El Bekri, ed. and trans. De Slane, 1857, pp.131-132).

The decline of the Almohad empire put Constantine under the Hafside rulers of Tunis (1230) until the 16th century, a period characterized by frequent rebellions and wars. The arrival of the Turks in North Africa re-opened another era of trouble for Constantine. The first attempt by the Turks to annex the town was made as early as 1517. The town was selected as the capital of the eastern province of the Turkish regency of Algiers (Geographical Handbook Series, 1944, p. 73). The 18th century marks the zeniths of the Turkish administration at Constantine, which saw the erection of many constructions.

During the French occupation (after 19 unsuccessful attempt to occupy the city; *ibid*, p. 73), Constantine became an army headquarters and the base of military operations in the eastern provinces. It was later proclaimed the capital of the region and since the town has developed considerably.

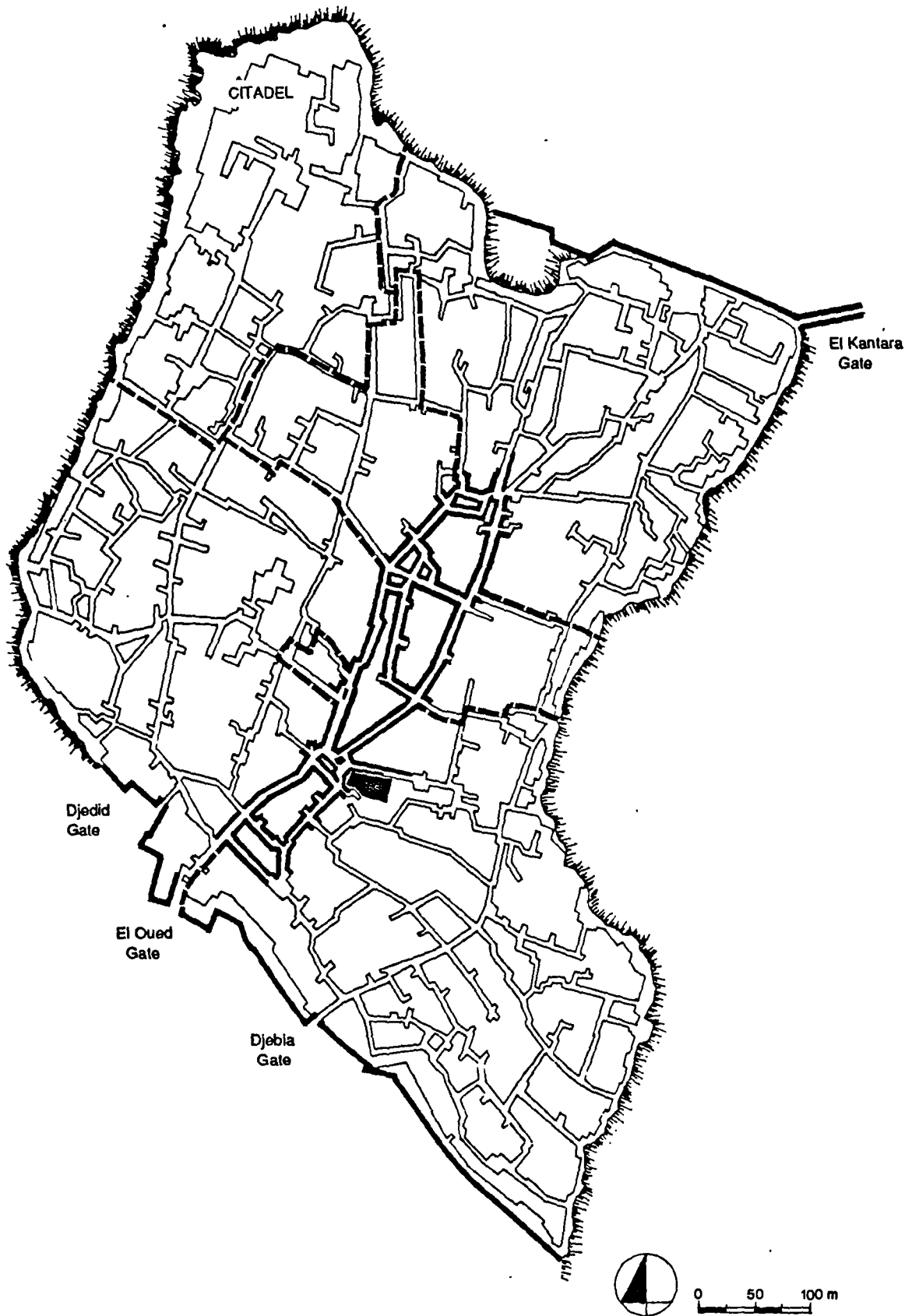
CHARACTER OF THE URBAN FABRIC:

The old city of Constantine within the walls describes an irregular trapezoid shape of about 40 hectares. The town is only partially fortified by defensive walls (of about 9 to 10 metres high). The inaccessibility of the site on the river sides made all contacts with the outside world via the south-west side, in which three gateways are situated (Bab el-Oued; Bad-Jdid; Bab Jabia). A fourth gateway, Bab El-Kantara, exists on the north-east side mainly used as an accessway to the river for water supply to the town.

The ground plan shows a very compact urban fabric constituted by blocks of irregular shape, serviced by narrow streets, several of them in the form of cul-de-sacs (see fig. 2.12). Many streets appear to intersect at almost right angles by contrast to Tangier or Algiers. Occasionally, streets widen out into small squares, and in many instances they are covered up by buildings. Several peripheral houses are built right against the cliff, preventing therefore a free circulation around the town.

The examination of the plan shows no dominance of any street in terms of either length or width. The market consists of a few narrow streets in the central part of the town, bounded by rows of small shops, boutiques and workshops, running across the town from "Bab-Jdid" and "Bab-el-oued" in the direction of the north-eastern gate. These streets accommodate numerous markets, each with specialized trade and crafts, which according to Mercier, amounted to over 20 different types of crafts in the eve of the French occupation (Mercier E., 1878, vol.40, pp. 59-96). The market of Constantine was once the most important in the whole region. It was the centre of diverse commercial activities, a centre of import and redistribution of goods for the entire region. Al-Idrissi in the 12th century describes Constantine as:

"a populous and commercial town. The inhabitants are rich; they make agreements with the rural population and co-operate with them for the cultivation of silk and the preservation of harvest. Their granaries are so good that corn may be kept in them for a century without suffering any deterioration. They collect large quantities of honey and butter, which they export to the outside." (Al-Idrissi, ed. and trans. Dozy and Goeje, III, 1866, p. 265).



CONSTANTINE

FIG. 2.12: GROUND PLAN

- Market street
- Quarter boundaries
- Town walls

The great mosque is located nearby the market area in proximity of Bab-el-oued gate (see plan, fig. 2.12). In addition to the great mosque, there are about 10 fairly important mosques, 12 religious lodges and a large number of small mosques, most of which are annexed by Qoranic schools (*) for children (Nouschi A., 1955, pp. 371-387). The old city contains also a large number of other types of public amenities, such as secondary schools, public bakeries (about 18) and public baths (about 20).

The city of Constantine was once divided up into five main quarters, known as "Casbah" to the north-west, "Tabia" to the south-west, "El-Kantara" to the north-east, "Bab-El-Jabia" to the south-east (see Plan in fig. 2.12) and the "Suqs" quarter in the central part of the town (Institut d'Architecture et d'Urbanisme de Constantine, 1980, p. 13). However, the examination of the ground plan indicates no visible physical features expressing the existence of these quarters.

(*) According to Nouschi, the old city of Constantine contained about 90 schools for young children and 7 secondary schools (Nouschi A., 1955, pp. 371-387).

THE TOWN OF MEKNEÛ WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Meknes is built on the flank of a mountain ridge, 40 miles west of Fez (see Location map, fig. 2.1, p. 64). It is situated in the central part of Morocco at the junction of important roads, such as the roads from Rabat to Fez and the Tangier road. The temperature rarely exceeds 30 degrees centigrade, or falls below 5 degrees (Geographical Handbook Series, 1942, vol. II, p. 52). The climatic conditions and the abundance of water supply makes the plain of Meknes one of the best agricultural and most fertile lands of Morocco. The population of Meknes within the walls exceeds 30.000 inhabitants (ibid, p.53).

THE COURSE OF TIME AND HISTORY NOTES:

Little is known about the early history of the region of Meknes in the Roman period nor in the centuries which followed. But according to some sources, the foundation of Meknes goes back to the 10th century where the Miknasa, a section of the nomadic "Zenata" tribe settled and established a collection of villages with gardens in the plain of Meknes (i.e., Leo Africanus, trans. and ed. Epaulard A., 1956; Geographical Handbook Series, 1942, p. 53). Under the "Almoravids", these villages were grouped together to form a stronghold of the "Tacarart" mentioned by El-Idrissi (Al-Idrissi, trans. de Goeje, vol. III). In 1150 and after a long siege, the town fell to the Almohads and was almost entirely destroyed; but at the end of the century, it was

re-built and regained importance. During the "Almohads" and later the "Merinids", the town saw great prosperity and a particular increase in the building activity (Geographical Handbook Series, 1942, p. 53).

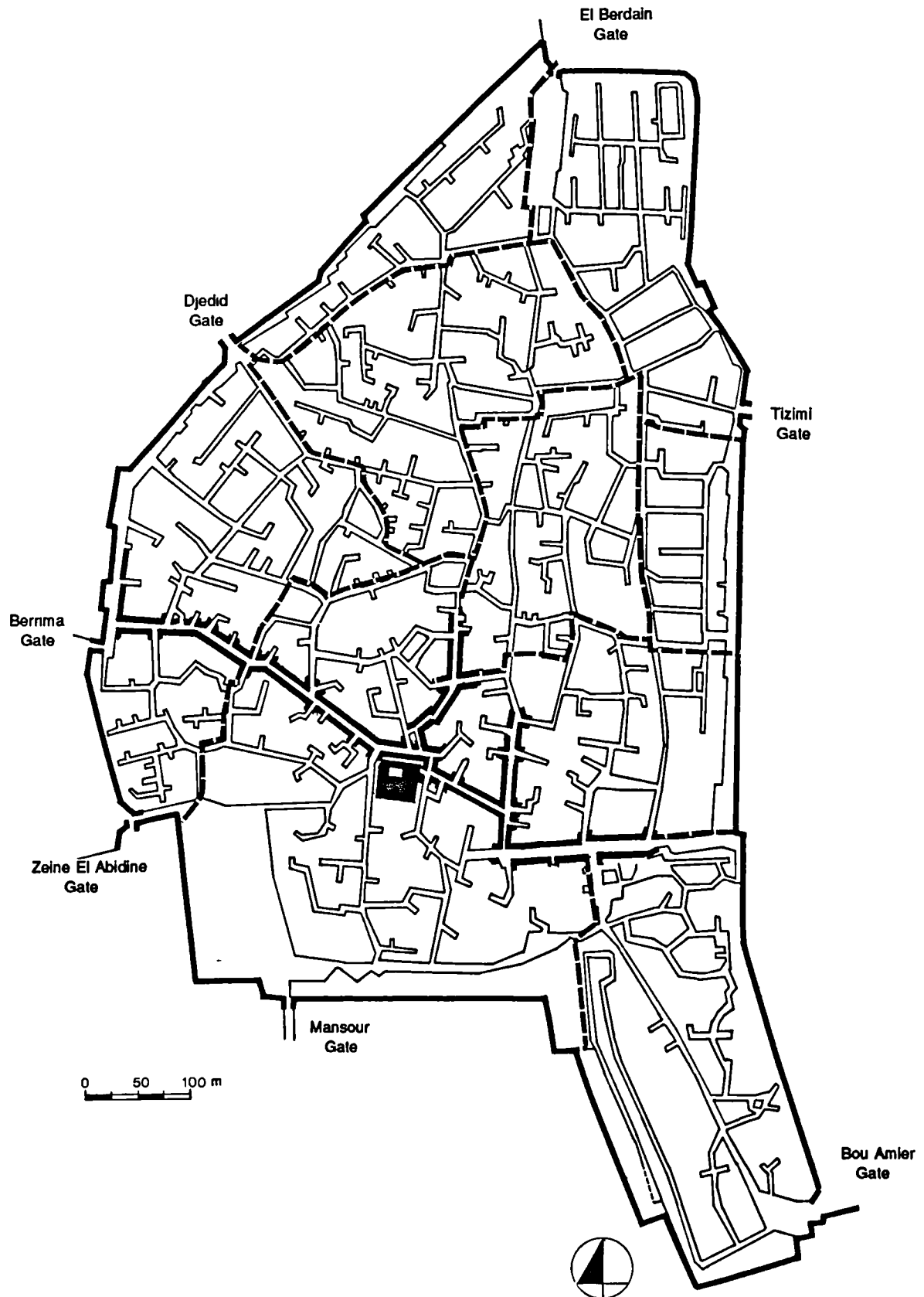
The decline of the "Merinid" dynasty made Meknes an easy prey for the rising Muslim brotherhoods during the 15th century (*), until the days of "Moulay Ismail" in the 17th century, who wanted to make a "Moorish Versailles" of Meknes, which became simply the framework for his splendour and the scene of his extravagances (ibid, pp. 53-55). The many palaces and defensive edifices and granaries found today in Meknes date from this period. After his death, the town suffered for a long time from intestine wars and attacks from the neighbouring tribes, until 1911 when Meknes passed under the French Protectorate.

CHARACTER OF THE URBAN FABRIC:

Meknes is one of the towns which has retained its original character most unaffected. The town is deployed on an irregular area of about 45 hectares, excluding the vast ruins of the citadel of "Moulay Ismail" which lie to the south-east of the town. The walls that surround the city on all sides have several gates (see Ground Plan, fig. 2.13), with "Bab Al-Khemis" the only remaining gate of the imperial citadel seen as one of the finest and best proportioned gates in the city (*).

(*) It must be noted that the towns of Morocco and the whole country have never been conquered nor administrated by Turks.

(*) The important gates are known as "Bab El-berdain", "Bab Berrima", "Bab El-djid", "Bab Tizimi" and "Bab Mansour".



MEKNES

FIG. 2.13: GROUND PLAN



Market street
Quarter boundaries
Town walls

**MEKNES**

FIG. 2.14: AERIAL VIEW

The plan of the town in Figure 2.13 (see also Aerial View, fig. 2.14) shows a compact built fabric serviced by an intricate network of roads, alleys and cul-de-sacs, but the streets at the eastern periphery present more regularity in their configuration. There is one large open space at the south with a direct gateway to the imperial city, and another much more elongated close to "Bab Berdain". The markets streets, which run east-west in the southern part of the city, between the religious college and the great 13th century mosque. The town contains about 19 mosques of various sizes and 10 religious lodges scattered all over the surface. Vast spaces outside the western and the south-eastern walls are occupied by cemeteries which prevented the growth of the town in these directions. The north western cemetery contains the mausoleum of "Sidi Aissa", the patron-saint of the Aisawa brotherhoods. This saint is commemorated every year by the "Aisawa" followers who come from all over the country and even from Algeria and Tunisia. The town is divided up into 9 quarters of which boundaries are set up in Figure 2.13 (Akcura N., 1978). These do not include neither the "imperial town" which develops within its own wall, nor the Jewish quarter added at a later stage which is located beyond the town walls (Kasba 64 Study group, 1973, p. 283).

THE TOWN OF FEZ WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Fez, a town of northern Morocco, lies in a valley situated at the cross-roads of the two most important axes of communications, the north-south axis which links the Mediterranean coast to the southern regions; and the east-west axis which links the east to the Atlantic coast (see Location map, fig. 2.1, p. 64). The climate of Fez is in many respects similar to that of Meknes, with temperatures ranging from 5 degrees in winter to 30 degrees in summer (Geographical Handbook Series, 1942, p. 43). The abundance of water in the region makes the site of Fez one of the most fertile in Morocco. The population of Fez was estimated at the 16th century at about 200.000 inhabitants (Gaudio A., 1982, p. 219).

THE COURSE OF TIME AND HISTORY NOTES:

The history of Fez is closely bound up with that of the country. Founded in 789 by Idriss I from Baghdad, Fez was for many centuries, the capital of several dynasties. The first settlement lay on the east bank of the river Fez and it was Idriss II who undertook the construction of a new town on the west bank and made it his capital (i.e., Levi-Provencal E., 1938, pp. 23-52; Geographical Handbook Series, 1942, p. 43). The arrival of several thousands of refugees from Cordova and Kairwan was decisive in the development of the city. The Moors settled in the east bank district, while the Kairwanis occupied the western part (Geographical Handbook Series, 1942, p. 43).

Under the "Idrissid" rule (A.D. 788-1050), the town suffered from dynastic quarrels and internal disputes; and by the end of the 10th century, it became the battlefield in the struggle for supremacy between the "Umayyads" of Spain and the "Aghlabites" of Ifrikiya (Kairwan, Tunisia). In 1069, the "Almoravids" conquered Fez, during which period the town greatly developed and prospered (Levi-Provencal E., 1957, ii, pp. 117-120). It was the "Almoravids" (A.D. 1060-1147) who brought the two original settlements built on either side of the banks into one city by dismantling the separating walls, and greatly improved its amenities (Geographical Handbook Series, 1942, pp. 43-44). The great sanctuary, the "Karawiyyin" mosque, dates from that period.

It was taken by the "Almohads" in 1146 only after a hard siege and a violent resistance from the "Almoravids" (ibid, p. 44). The town walls were destroyed and were to be re-built only when the "Almohads" had the insurance of their control over the whole country. The town grew afresh and flourished under the "Almohads" and saw a development of economic progress. A century later, the town changed masters again and passed under the authority of the "Merinids" (A.D. 1248-1549), and remained the capital throughout the dynasty. During this period, the town with a population of 200.000, saw a building activity, especially regarding the construction of housing areas and colleges. A royal and administrative town was erected to the west, at first named "Medina Al-Bayda" (the white city), but later as "Fez-el-jedid" (the new Fez). The new quarters enclosed essentially the royal palace, various administrative and military buildings, a great mosque and residences for the Merinids dignitaries (i.e., Gaudio A., 1982).

Fez became then a commercial and industrial city, famous for its textiles and leather goods, but also a centre of art, a city of religion and learning, where around the great mosque (*), flourished the colleges and university of Fez. For three centuries, Fez enjoyed a political, economic and intellectual supremacy throughout Morocco.

In 1549, the "Saadi" already masters of Marrakech, conquered Fez and relegated it to a second place after Marrakech. Fez entered a troublous era and the darkest period of its history, when the whole country was in a state of anarchy. Fez was delivered to the caprices of ephemeral rulers until 1666 when the "Alawids" (A.D. 1659-Present) took possession of the town. Today, Fez is considered as the most well preserved and a survival illustrative medieval city of Muslim civilization. In 1980, the medina of Fez benefited from an international programme (under the direction of UNESCO) to safeguard the old city (i.e., Gaudio A., 1982).

CHARACTER OF THE URBAN FABRIC:

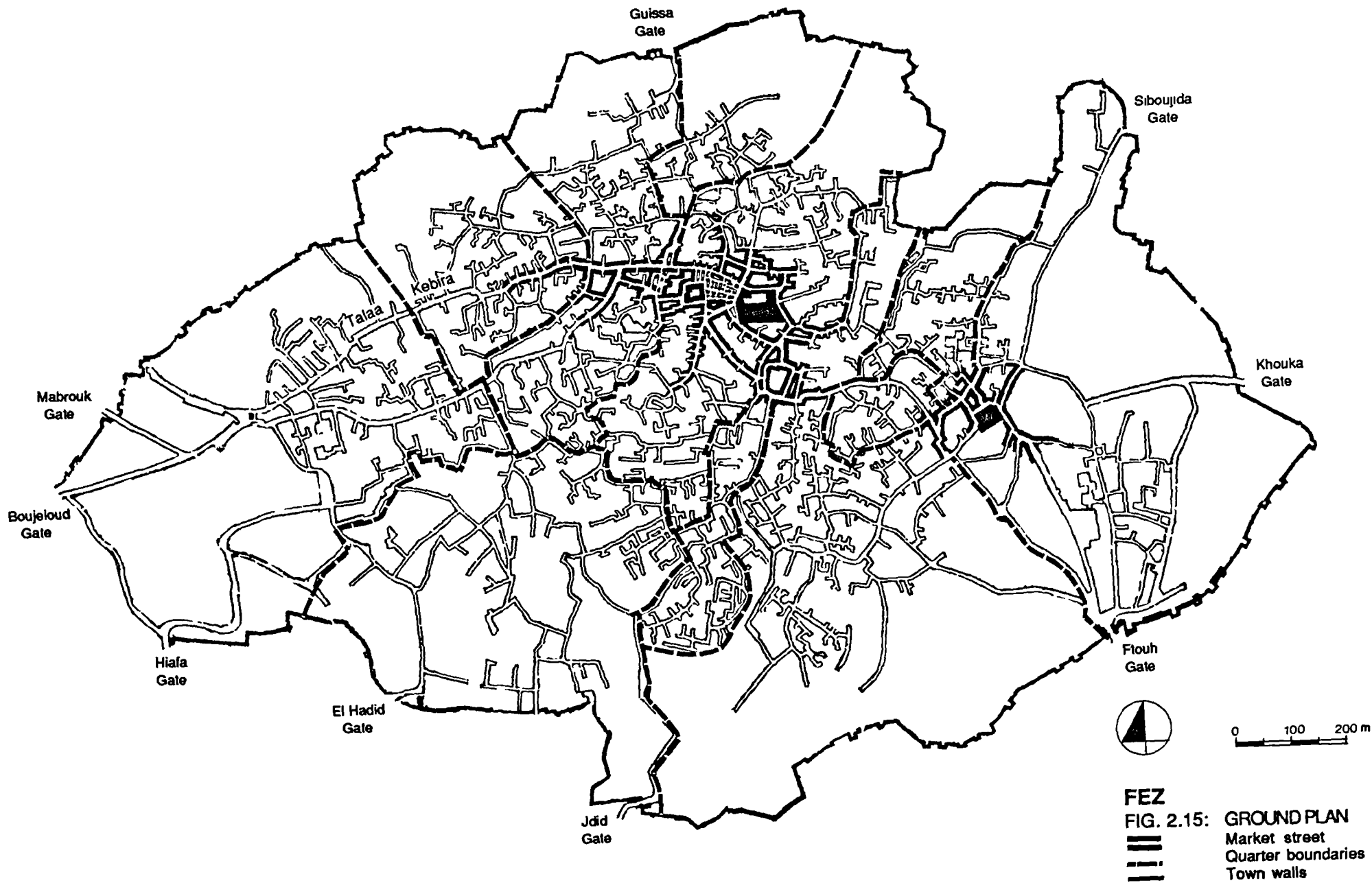
The town lies chiefly in a slight depression, with parts of it being built upon the steep sides of the ravines of the river of Fez. In fact, Fez consists of two distinct towns separated by open spaces and gardens, "Fez-el-bali" (the old Fez) and "Fez-el-jedid" (the new Fez), the royal town built during the "Merinid" dynasty. However, the present study concerns only the old Fez within the walls.

(*) Karawiyyin mosque, according to Gaudio A., was one of the earliest universities in the world together with the university of Bologna (A. Gaudio, 1982, p.28).

The old city developed concentrically on the two banks of the river linked by three bridges, and covers a total area of over 210 hectares including large peripheral gardens. Today, the river has been partly covered up by a large boulevard. The fortification walls are pierced by eight massive gates, located at almost regular intervals around the city, three of which "Bab Guissa" to the north, "Bab Bou Jeloud" to the west and "Bab Ftouh" to the south-east, are the most important.

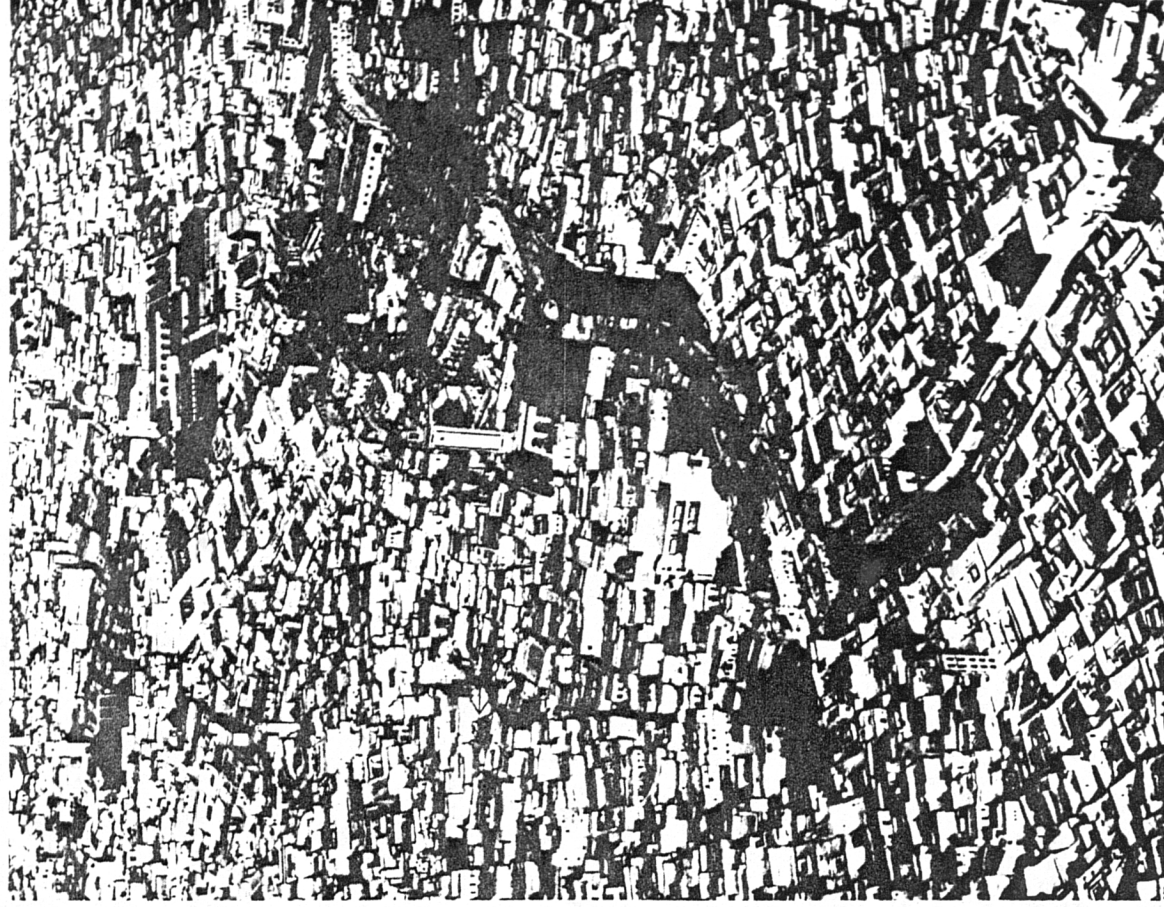
The plan of the city in Figure 2.15 shows a massive and compact built-up fabric (see Aerial Views, figures 2.16, 2.17) serviced by a street network which appears at first sight very irregular characterized by a highly distorted short alleys often sharply-angled, and visibly a large number of long cul-de-sacs with several changes of direction. Very few street widenings or open squares can be noticed in the city. In spite of the large size of the built-up area (over 200 hectares), the town comprises only 149 blocks as much as in Algiers which expands over an area of only 45 hectares. This seems to result in larger blocks requiring then much deeper dead-ends, which give a distinctive character to the urban fabric of Fez.

The plan shows only three long streets which appear more dominant by their width and fairly regular. "Talaa Kebira" and "Talaa Seghira" streets run both from the gateway "Bab Bou Jeloud" towards the centre of the city, where the market streets and the main mosque are located. These correspond to busy streets fringed on most of their parts, by rows of shops and workshops and give access to numerous markets (Gaudio A., 1982, p. 200). The third long street links in a less direct way the central part to the east bank.





FEZ
FIG. 2.16 : AERIAL VIEW



FEZ
FIG. 2.17 : AERIAL VIEW

In the market section, trades of different kinds (over 50 according to Gaudio A., 1982, p. 200) are grouped in separate streets and areas. Gaudio counts over 520 workshops employing over 20.000 workers, and about 300 mills (ibid, p. 200). The most important markets correspond to a smart covered shopping area specialized in luxury goods and recognizable by the orthogonal street pattern along which they develop; the grocery market, wax and candle market, the wool-dyers and the tanners' quarter and on the eastern bank in close proximity of the gate "Bab Ftouh", the pottery and the silk weavers markets.

The great mosque ("Al-Karawiyyine") is located in the centre of the trading quarter, surrounded by four colleges (*). Four other colleges exist in the old Fez, two of which are on the east bank. The most grandiose and largest one is "Bou Inaniya" built in 1357, which stands on the main streets of "Talaa Kebira" street. The city contains also hundreds of mosques and religious lodges, which amounted to 785 mosques between the years 1199-1214 (ibid, p. 219). The second largest mosque (known as "El-Andalus"), is located on the east bank in proximity of "Bab Ftouh". In addition to these religious and educational buildings, there are about 120 Qoranic schools, 30 libraries, 22 public baths and about 300 mills (Kasba 64 Study Group, 1973, p. 291). In the city, the houses rise vertically mostly on two floors, built around courtyards. Between 1199-1214, there were about 89.236 houses (Gaudio A., 1982, p. 219). The old city of Fez is

(*) The four medersas or colleges are: "Es-seffarin", the first Merinid medersa in Fez founded in 1271-72; "El-Attarin" (1346); "El-Mesbahiya" (1346-47) and "Ech-cherratin" built during the reign of Moulay Rachid, 17th century.

divided up into 18 quarters (see fig. 2.15) with a population of 125.000 (Ibid, p. 219; Kasba 64 Study Group, 1973, p. 292). Due to the very small size of some of these quarters, the final division of the town taken into account in the analytical chapter shows a total of 13 quarters with the smallest being considered with their immediate neighbouring quarters.

THE TOWN OF KAIRWAN WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

Kairwan, the "Makkah" for the north African Muslims, is located in south Tunisia, at about 104 miles south of Tunis and 37 miles south-west of Susa. It is situated in the centre of a wide-stretching sandy plain (see Location Map, fig. 2.1, p. 64). Hammerton expressing his first impression of the town writes:

"...Suddenly the horizon gleams white, just like a mirage, and a great tower, countless domes and minarets around it seems to spring into existence out of the very stones of the desert... Far from any trade route, in sterile country with no natural attraction, one wonders once again why on earth such vast and impressive buildings took place here." (Hammerton T., 1959, p. 93).

Temperatures vary considerably, ranging from a few degree below zero in winter to 40 degrees centigrade and over in summer. In spite of this unfavorable location in the middle of a featureless region, Kairwan has been an important staging point for caravans in their long journeys from

the south and west towards the Mediterranean ports. Today, it is still at the centre of an important network of roads converging from several directions. However, the Holy and venerated town of Kairwan has lost over the centuries its role of a great metropolis. Its population has been differently assessed by various sources. For instance, Playfair gives an estimate of 15.000 inhabitants in 1877; while Hesse-wartegg estimated it in 1882 at 30000 (*).

THE COURSE OF TIME AND HISTORY NOTES:

The foundation of Kairwan is traditionally attributed to "Okba Ibn Nafi" (7th century), but according to some sources, the site had been formerly occupied by a Roman or Byzantine town (1*). Throughout the centuries, the site of Kairwan has been subject to constant attacks. It was in the 7th century (670 A.D.) that Tunisia was annexed to the "Umayyad" dynasty of Damascus after successive campaigns headed by "Okba Ibn Nafi" (i.e., Ibn Idhar, ed. and trans. Colin and Levi-Provencal, 1948, vol. i, p.15). "Okba" made Kairwan a capital where he established two institutions: the great mosque and the government house, built opposite to each other (ibid, pp. 19-20). "Okba Ibn Nafi" was killed in Tahuda (south Algeria). Kairwan became then, but only for a short time (684-9), the capital of the Berber kingdom, and for

(*) The population of Kairwan was 47.000 during the census of May 1966 and 56.000 people in 1972 (National Census, Tunisia).

(1*) During recent restoration work (1969-72), various materials have been discovered including some Roman items in the foundations of the great mosque. El-Bakri states that the "suq al-darb" was occupied by a church in antiquity (El-Bakri, ed. and trans. de Slane, 1965, pp. 22/52-53).

several decades, it remained the stage of many disputes and a battle-field between various groups of different religious sects (Sufri, Ibadi *). During the 8th century, Kairwan was in the course of becoming an important centre of Muslim civilization; and a century later, it became along with Kufa and "Al-Madina" (Saudi Arabia) one of the great capitals of religious sciences (i.e., Ibn Nadji, 1902, vol. ii, p. 38).

At the beginning of the 10th century, the town passed under the reign of the "Fatimids" of Egypt (i.e., Ibn Al-Athir, 1966, vol. viii, p. 53) and an era of stagnation followed for Kairwan. The transfer of the "Caliphate" to Cairo in 972 came as a severe blow to Kairwan, which lost for ever its role as a capital. In the 11th century, the town entered an era of darkness and experienced famine and epidemic diseases. Al-Idrissi notes that before the "Almohad" conquest (beginning of the 12th century), Kairwan was only a ruin in the hands of the nomads "Beni Hillal" (El-Idrissi, trans. and ed. Peres, 1957, p. 80). During the reign of the Almohads (1147-1269A.D.), Kairwan saw a relative peace, which allowed the town to rise a little from its ruined state and for several centuries, little was heard of it until the end of the Hafsid reign.

In the middle of the 16th century, the town passed under the Turkish administration which accentuated its decline, until the reign of the

* In 757-8, the "Warfadjuma" Kharijis of Sufri tendency, seized Kairwan. It was liberated in 758 by the Ibadhite army who left as a governor Ibn Rustum, the future founder of the kingdom of Tahert (Ibn Idhari, ed. and trans. Colin and Levi-Provencal, 1948, vol. i, p. 76).

"Husaynids" (1705-35), during which Kairwan recovered (*). Al Sanadj (1736-7) noted that "At this moment after Tunis, no larger town than Kairwan is known in all of "Ifrikiya" (present Tunisia). Among its inhabitants are the best scholars, the most skilful people." (Hulal, ed. Al-Hila M.H., 1970, vol. i, p. 244).

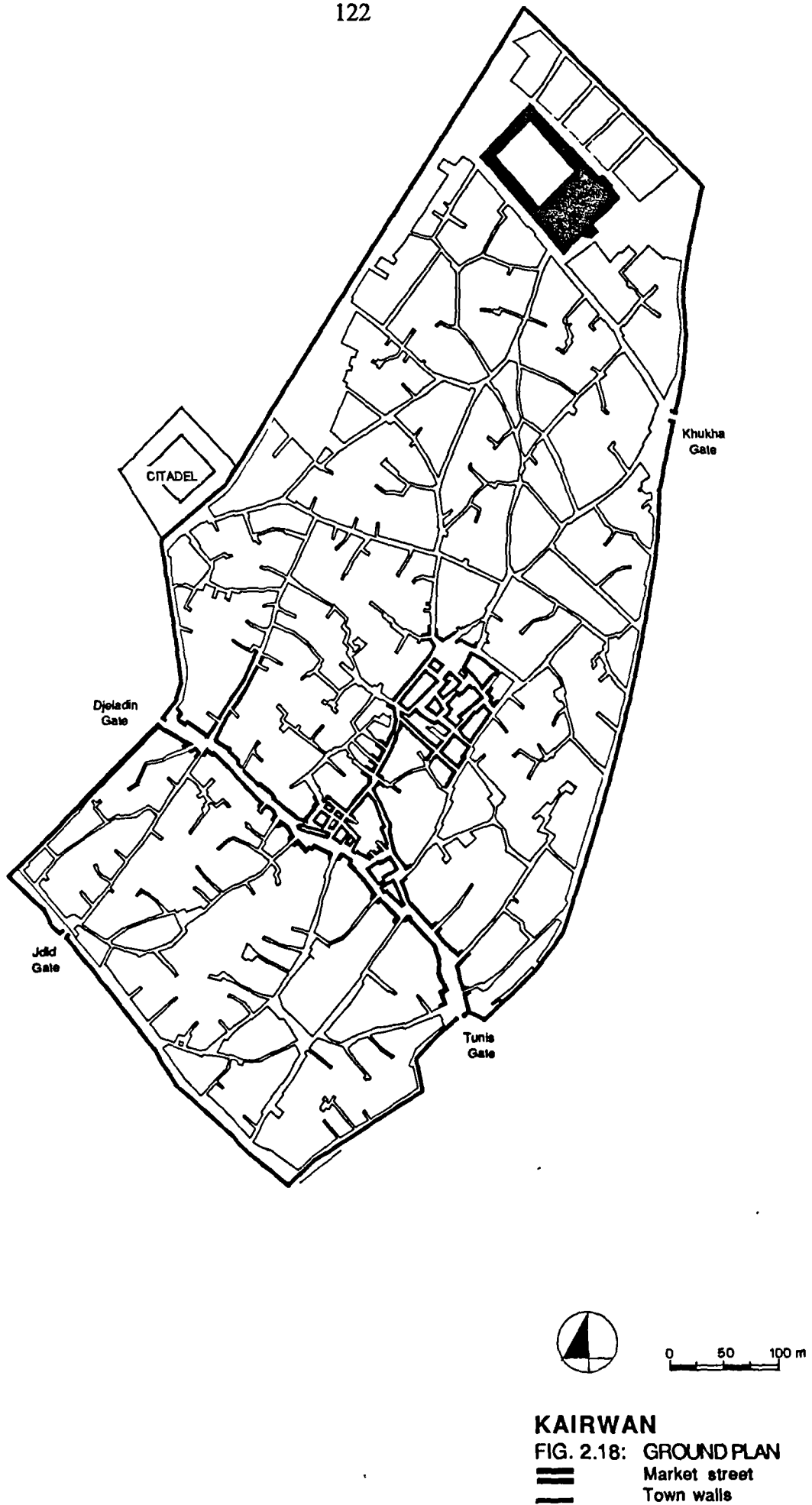
Later in 1881, Kairwan as the rest of Tunisia entered under the French Protectorate until the independence in 1956. At the present time, the town benefited from several programmes of innovation and restoration to safeguard and preserve its character.

CHARACTER OF THE URBAN FABRIC:

Kairwan, the holy city venerated as the third most important in the Muslim world, is enclosed on all sides by an impressive brickwall(*) with seven irregular sides, about 9 metres high and inscribing a circuit of 3125 m. The wall is kept clear of the peripheral buildings, allowing therefore free circulation all around the town. The town within the wall covers an area of about 49 hectares, and has four gateways (locally termed Bab-Tunis, Bab-Djid, Bab-Jelladine and Bab-El-Khouka, see Ground Plan, fig. 2.18).

(*) According to Desfontaines, who visited Kairwan in 1784, it was "the biggest in the kingdom after Tunis; it was even better built and cleaner than the latter." (Desfontaines L.R., 1838, vol. ii, p. 61).

(*) The wall was built in 1052, but restored considerably in the beginning of the 18th century (Thurston H., 1973, p. 234).



The ground plan of the town in Figure 2.18 shows an erratic network of narrow streets and lanes, many of them cul-de-sacs, often described as well-paved and unusually clean. For example, Hesse-wartegg comments that "Kairwan is one of the few towns which can be traversed without dirtying one's shoes." (Hess-wartegg E.V., 1882, p. 247). The most important streets in the town run adjacent to the great mosque at the north-western corner of the city and across the city from the gate "Bab Tunis" to the "Bab Jelladine" gate. This latter, though unusually wide directly links the market area to the outside of the walls. On either side of this street lies a row of small shops. Boddy gives a vivid description of the atmosphere and dense activity in these market streets when he writes:

"...the first impression as one enters the bazaars is vague and confused. From the narrow streets crudely bright, one passes under the dark arches, where objects can be distinguished with difficulty... The real charm of the bazaar is in contemplating the movements [of people] encountering and mingling with each other... Immediately after the [afternoon] prayer, the galleries of the bazaars become the theatre of an auction sale... It is then that the tumult becomes indescribable. One's ears are deafened by the various noises and it is with the greatest difficulty that one succeeds in moving about..." (Boddy A.A., 1885, pp. 190-191).

The covered markets are in the centre of the walled town. They are long passages covered with an arch roof which rests on massive columns with large capitals, where merchants spread out their wares. The shops are small recesses 2 to 3 feet above ground, facing narrow stone pavements serving as a display area between which run through the streets like little ravines (ibid, p. 190). Nearby the suqs lies a sacred well, the waters of which are venerated and which became a place of pilgrimage (Thurston H., 1973, p. 235).

The walled town of Kairwan is full to overflowing with mosques and religious lodges. There are about 63 mosques and over 100 religious lodges in and around the city (with 23 mosques and 90 religious lodges within the walls; Ibid, p. 237). The mosque of "Sidi Okba" located at the north west periphery of the town, is the greatest of all Tunisian mosques, built in the turn of the 7th century and has about 296 columns (Ibid, p. 230). Another mosque of no less importance is the mosque "Tleta Bebane", built in 886 A.D. (Ibid, p. 235) and located at the eastern part of the town.

THE TOWN OF WARGLA WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

The oasis of Wargla lies within the largest, hottest and most barren desert on earth. The town is situated at 800 kilometres south of Algiers (see Location map, fig. 2.1, p. 64) in the low valley of the underground river Miya, in the heart of a large palm grove with over 400.000 date-palm trees (Rouvillois-Brigol M., 1975, p. 50). The town within the walls covers an area of approximately 30 hectares. The climate in the Wargla region is extreme, with temperatures exceeding 40 degrees centigrade in the hottest months, with a minimum of 5 degrees centigrade. With a population of 53.000, of whom 30.000 live in the old city, Wargla stands now as the largest town in the Sahara (National Census, 1976).

THE COURSE OF TIME AND HISTORY NOTES:

Wargla is an extremely ancient centre of civilization, which according to archeological records has been continuously peopled, though there has been no reference to it by Roman authors.

According to Ibn Khaldun, the population of Wargla originates from the Berber Zenata tribes converted to Islam, after the Muslim conquest of the 7th century (Ibn Khaldun, trans. De Slane, 1934, vol.3, pp.285-287). The 8th century saw a rise of the fundamentalist sect of the Islamic puritanism known as "Ibadhism" in North Africa, and for many centuries the region of Wargla became a refuge place for all persecuted Ibadhites. In 909, after the destruction of Tahert, the capital of the Ibadhite kingdom, the Sovereign of Wargla welcomed the expelled Ibadhites, who founded Sedrata and many other villages nearby Wargla. These were well sited for trade and quickly flourished, but also attracted other persecutors. Sedrata was destroyed in 1075 and part of its population fled to the Mzab valley, while a minority settled in Wargla (Donnadieu and Didillon, 1977, p. 29).

The Mzabites (inhabitants of the Mzab valley) maintained, until a recent time, close relationships with the Warglis, who were probably the pioneers of the trans-saharan trade. In the 12th century, El-Idrissi describes Wargla as "inhabited by rich families and merchants who, in order to trade, went as far as Ghana and Sudan, where they extract gold which is brought back to Wargla and stamped in one of the remote places of the city." (El-Idrissi, trans. Peres H., 1957, p. 141).

The strategic geographical location, coupled with a flourishing agriculture made Wargla a long anticipated halting point and a half way station for all caravans, travelling from north to south, and according to Ibn Khaldun a gateway to the desert (Ibn Khaldun, trans. De Slane, 1934). It became the "metropolis" of the region where more than a hundred settlements were founded. However, as the prosperity of Wargla grew, so did its attraction to the "Beni Hillal" nomads who constantly attacked the city, in addition to internal conflicts mainly due to religious differences between the inhabitants.

In spite of several centuries of conflicts and war, the description of Leo Africanus who visited the city in 1526 refers to Wargla as:

"a walled city with beautiful houses and very rich artisans trading with Agadez kingdom, crowded with merchants from Constantine and Tunisia..., and the Sovereign had more than a thousand horsemen." (Leo Africanus J., Trans. Epaulard A., 1956, vol.2, pp. 438-9).

Harassment from the "Beni Hillal" persisted, and the town council decided to seek protection from the Turks who already occupied the north of the country. This protection quickly showed to be inefficient as not only the attacks persisted from the nomadic tribes, but these obtained exemption from paying taxes to the Turkish administration and were assigned the task of collecting tributes from the Warglis. This difficult situation led in 1602, the council of Wargla to appeal to more powerful overlords, the "Sa'adians" from Morocco, during the reign of Moulay Alahoum, who became the first sultan to govern in Wargla. The "Alahoum" dynasty consolidated its authority over the years, mainly by playing on the rivalries between the three existing

clans: Beni Waggin, Beni Brahim and Beni Sessin (Brigol R.M., 1975, p. 51).

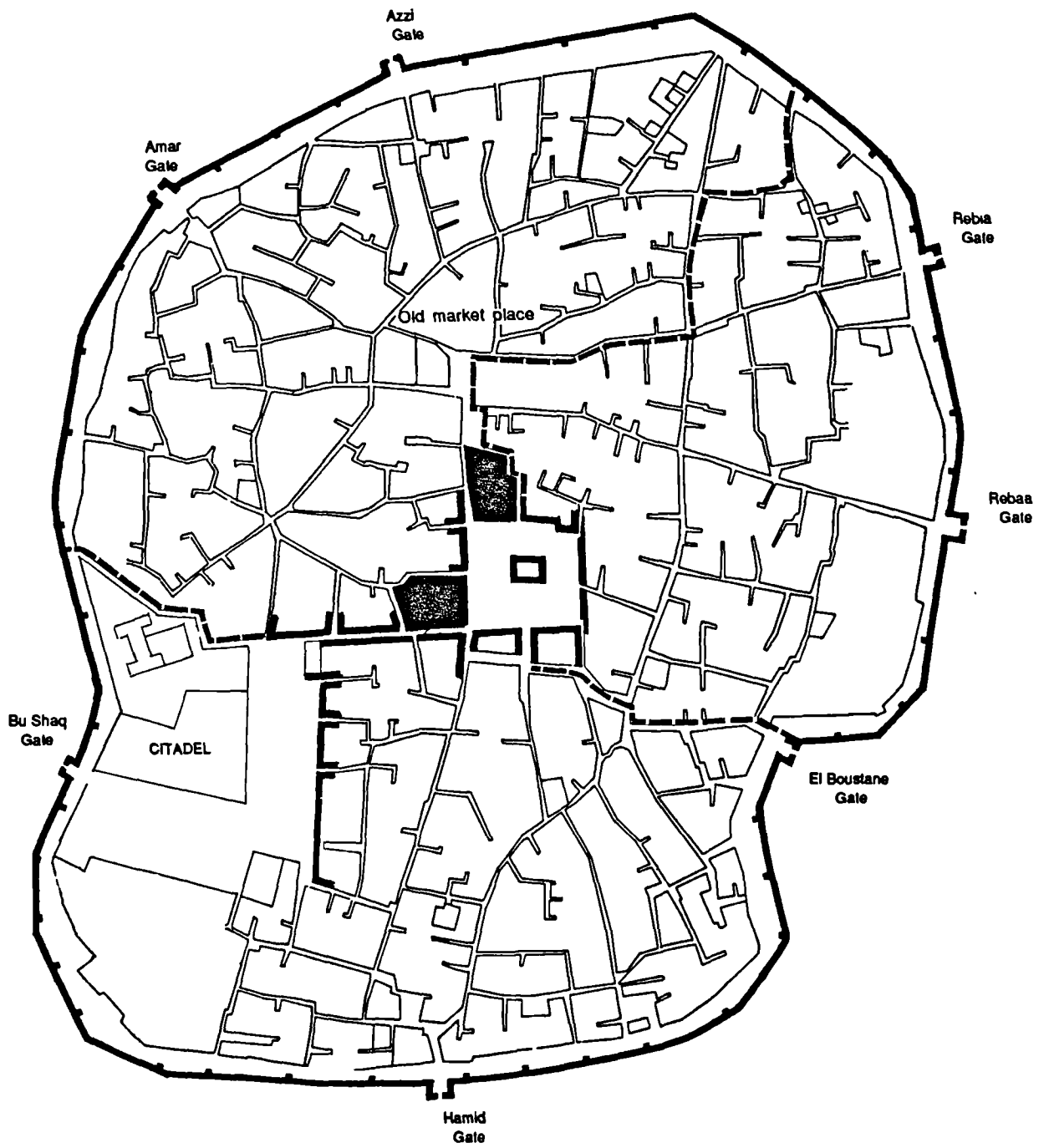
At the beginning of the 18th century, a permanent state of war prevailed in Wargla, due to a political anarchy (Turks, Sa'adians, Beni Hillal) supported by religious divisions of the local population (Ibadhite and Malekite). Wargla lost its preeminence and the control of the region went to N'goussa, the second largest neighbouring city, until the French occupation in 1830. The discovery of oil in the region in 1956 attracted a considerable number of new settlers seeking employment. After the independence, the town benefited from an important development programme and the entire nomad population settled in the region of Wargla.

CHARACTER OF THE URBAN FABRIC:

The individual character of Wargla, unlike for example the Mزاب towns, has neither been acknowledged as giving rise to some visually satisfactory built environment, nor has it been the subject of considerable studies. The overall layout of Wargla when perceived from an aerial photograph (see Aerial photo, fig. 2.20) appears as an animated succession of contrasting cubical forms, solid and void, light and dark. The walls that formerly surrounded the town have been destroyed and the ditch filled up in 1882, and replaced by a boulevard. The town had seven gateways ("Bab Rebia" and "Bab El-Boustane" to the east, "Bab Azzi" to the north, "Bab Amar" and "Bab Bou-Shaq" to the west and "Bab Hamid" to the south).

The ground plan in Figure 2.19 shows blocks of houses of irregular shape and size, densely packed together and separated by narrow streets and cul-de-sacs that are often covered up by buildings spanning over to form tunnel-like effect. The street network especially in the north-western part, is characterized by sharp bends and sudden shifts of direction, giving a sense of confusion. But, the overall layout seems to exhibit some kind of regularity and order.

The examination of the plan shows three fairly regular streets, running north-south from the vicinity of "Hamid" gate towards the market square and from the vicinity of "Boustan" gate towards the northern edge; and east-west from "Rebaa" gate to the great mosque. A citadel, built at the beginning of the 17th century during the "Alahoum" dynasty, occupied the western part of the town. The central market of almost perfect square shape which is directly linked to the citadel by a commercial street, dates most probably of the same period. The original market was located north of the present market square. The southern quarter was partly destroyed by the French army in 1872 in order to make way to a "place d'arme". At the present time, the site of the old citadel accommodates a health centre. The market place at the centre of the town constitutes the only large open space; but a series of smaller squares can be found all over the fabric, many of which are adjacent to local mosques or found close to the town gates.



0 50 100 m

WARGLA

FIG. 2.19: GROUND PLAN

- Market street
- - - Quarter boundaries
- Town walls



WARGLA
FIG. 2.20: AERIAL VIEW

The town contains about 12 local mosques and over 20 shrines, with the most venerated shrine, "Qubba Sidi l'Wargli", of the common but rather mythical ancestor located in the open space adjacent to the "Malkya" mosque. The two main mosques representing the two dominant religious sects "Ibadhite" and "Malekite", occupy opposite corners of the market square. The town of Wargla was divided up into three quarters (Beni Waggin, Beni Brahim and Beni Sessin) with boundaries intersecting at the market place (see Map, fig. 2.19). Outside the walls, each of the three quarters had its own gardens and palm grove.

GUEMAR AND TAMELHAT WITHIN THE WALLS:

GEOGRAPHICAL SETTING:

The town of Guemar is located in the Souf region, south-east of Algeria, close to the Tunisian border (see Location map, fig. 2.1, p. 64). The settlement occupies an even terrain, and its population according to Bataillon exceeded 8000 inhabitants (Bataillon C., 1955, p. 38). About 20 settlements of various sizes are found in the Souf region, scattered on a area of 40 kilometres long, with El Oued playing the role of regional and administrative capital. The climate of the Souf region is characterized by high temperatures exceeding 50 degrees centigrade in summer and rare rainfall. Winds and sand storms are violent and are the most important physical constraint in the region.

Tamelhat is another Saharan settlement located in the "Oued Righ" region, at about 10 kilometres of Touggourt south-west of Guemar (see Location map). Tamelhat like Guemar, is only one settlement among several others (about 40), spread on a large area of 150 kilometres long. The settlement lies on a flat site surrounded by palm grove plantation. The climatic conditions are very similar to Guemar and are characterized by extremely high temperatures in summer.

COURSE OF TIME AND HISTORY NOTES:

Little has been written about the history of both the "Oued Righ" and the "Souf" regions. These regions are geographically isolated, due to their location in the middle of a vast territory of sand dunes with no important transaharan roads traversing it. This location has kept away the "Souf" and "Oued Righ" regions from the major historical events in the Sahara, and for many centuries, the "Souf" has been a refuge centre for several persecuted populations.

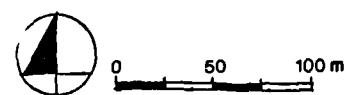
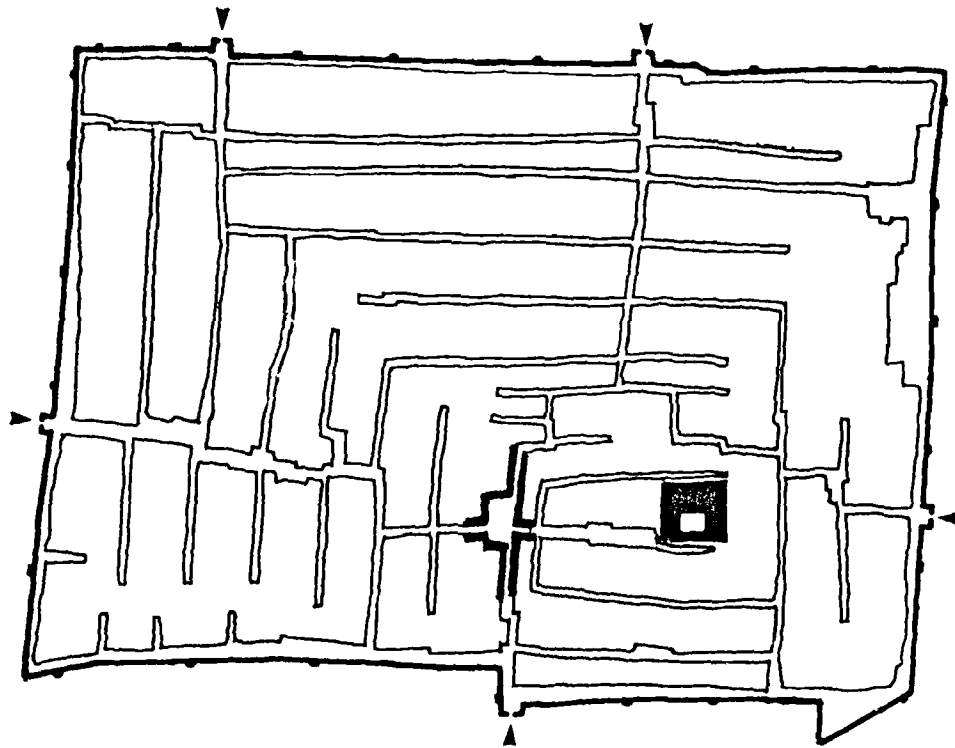
According to "Kitab El Adouan", the Souf region was peopled by the end of the 14th century by immigrant population from Syria which was expelled and prevented from settling in Kairwan (Trans. Feraud C., 1868, p. 31). The inhabitants belonged, according to Bruschvig, to the Orthodox Kharijit group of south Tunisia (Bruschvig R., 1947, p. 330). Guemar, one of the oldest and largest settlement in the region, was the headquarter of a "Sufi" brotherhood (Tijania), which founded its first mosque in the town in 1597. In 1850, the "Tijania" included more than 30.000 members (Mangin D., Panerai P., 1980, p. 63). After several conflicts with the Turks in 1826 and with another brotherhood

("Kadria"), the Tijania lost their influence over the region and decided to concentrate on the development of Guemar and Tamelhat. This latter constituted a second base of the "Tijania" brotherhood in the Sahara, which maintained the monopoly of trade in the south-east part of the country (Ibid, pp. 63-64).

CHARACTER OF THE URBAN FABRIC:

GUEMAR:

The towns of the Souf region are known by their dome-roofed buildings and the orthogonal street system. The settlement of Guemar is enclosed within walls, pierced by five gateways, one of which gives direct access to the market place from the outside. The ground plan in Figure 2.21 shows a relatively dense fabric, serviced by narrow and straight streets covered in some places and many of which in the form of long dead-ends. Most of the streets intersect at right-angle and form therefore a grid-like pattern. The town fabric is characterized by long blocks of single-storey courtyard houses, giving directly onto the streets, which are not paved but covered with sand. The plan shows one street with a distinct configuration: it is wider, more broken up and to which link more dead-ends than other streets. The "Tijani" sanctuary and college occupy a large area close by the market square, in the eastern corner of the town. The town contains also smaller mosques scattered over the surface.



GUEMAR
FIG. 2.21: GROUND PLAN
Market street
Town walls

TAMELHAT:

The town of Tamelhat occupies an area approximating a square of about 27 hectares. The ground plan in Figure 2.22, shows long and narrow blocks of one-storey courtyard houses, linked together by long and straight streets which form a very regular pattern. The plan shows only a very few dead-ends compared to the other towns. The religious complex of mosque and colleges occupies the south-eastern corner of the town, nearby a large open prayer area. The market place at the south-eastern edge of the town, is the converging point of three streets that directly link to the outside. Shops and workshops are grouped around the market place and along the neighbouring streets, and form the only commercial nucleus of the town.

DISCUSSION AND SCOPE OF EVIDENCE:

Chapter One has shown a characteristic set of claims underlying the studies on the internal structure of Arab towns. Many of these studies have exploded the myth of a prototypical city form reflecting socio- cultural requirements, in which the urban fabric is seen as divided into two distinct domains, the central public area with the great mosque and the market streets playing an essential role of structuring elements; and a private residential area, which is in turn divided up into separate quarters. The subdivision of the urban fabric into distinct compounds is seen also in the street system described as arranged according to a three-fold hierarchy.



TAMELHAT

FIG. 2.22: GROUND PLAN

 Market street
 Town walls



FIG. 2.23: AERIAL VIEW

A visual inspection of the site plans of the towns under study, reveals no clear picture of this acknowledged spatial model. On the contrary, the plans show a large variety of spatial configurations which cannot be disregarded, but raises doubts upon the interpretations brought about the structuring of space in these towns.

For example, the examination of the ground plans has clearly shown that the great mosque is not always located in the main market area, nor that it always occupies a central position with respect to the overall fabric. The position of the great mosque strongly varies from one town to the other. It is centrally located in Fez, Wargla and Tunis; but it is peripheral in Kairwan, Algiers, Susa, Tangier and Sale. In addition, some towns such as Wargla and Fez have more than one main mosque; others such as Guemar and Tamelhat have a monastery annexed to the great mosque. There is another important morphological difference between the towns in the location of the main market streets and their spatial configuration. By contrast to what is often assumed, the market streets do neither always develop in the immediate vicinity of the great mosque (i.e. Kairwan, Sale, Susa and Tamelhat) nor are they always confined to one single area. In most towns, these develop linearly along streets in the form of "bazaars" (i.e., Fez, Tunis, Algiers, Tangier); but in other towns, the market activities are organised mainly around a large open square, such as in Wargla, Guemar or Tamelhat. These variations in the positioning of the key town facilities (i.e. the Great Mosque and the market area) in the overall fabric and the spatial arrangement of the market areas are indications that individual morphological features exist in these towns, and therefore these towns do not present one single pattern. Moreover, all the observed differences raise some

doubt about the swift generalizations which characterize past studies on Arab towns.

These towns present also important differences with respect to the street pattern. A visual comparison of the ground plans of the towns shows, not only strong variations with respect to the overall grid deformation but also endless ways the streets, alleys and dead-ends interconnect to each other. Except for Guemar and Tamelhat, the streets tend to wind in and out, defining an intricate overall pattern ranging from a more regular grid to a "labyrinthin-like" type. It is obvious for instance, that the regular street pattern of Guemar or Tamelhat differs from the more distorted grid structure of Wargla or Sale, which in turn remain fairly regular when compared to the labyrinth-type of streets of Fez or Tangier. Therefore, there seems to be differences between the towns relating to the degree of distortion of their urban grid. In Wargla, Algiers and Meknes, there are parts of the street network which are more regular than others; while in Fez, the streets present greater deformity and the system seems to be much more broken up than the street network of for example Wargla. Furthermore, the plans show no rigid demarcation in the articulation of the open spaces as claimed by past studies, in which the street system in these towns has been characterized by a three-fold hierarchy with thoroughfares or primary streets directly connecting the central area of the town to at least two town's gates; streets giving access to the separate quarters or secondary streets; and the small alleys and dead-ends giving access to the individual houses. The maps clearly show that the cul-de-sac streets connect not only to the "secondary" street's types as defined by past studies, but also randomly to various streets including the "thoroughfares";

and the so-called "secondary streets", which are very difficult to distinguish in configurational terms, connect not only to "thoroughfares" but also to each other in an unlimited number of ways; and finally, the "thoroughfares" do not always link so directly to town gates.

Clearly, these morphological differences show that the spatial model used to describe the physical form of Arab towns is too abstract and too generalized to give a satisfactory account of the variations in the urban form of these towns. The inherent problem with the approach adopted in the past studies is that only features that can be easily "fitted" within the abstract model are seen as relevant. Even if one accepts the hierarchical spatial organisation of the urban structure as a general aspect in these towns, the question is not so much with its abstract logic as an ideal model, but with its relevance and usefulness in depicting the variations observed in the configurations of Arab towns. In fact, the variation in the density of use and occupancy, or to put it in other words, the degree of "publicness" of an area is not typical or distinctive only to Arab towns. Busy and less busy, quiet and quieter areas can always be observed in any urban system. The hierarchy principle which relates to a simple sequence from the "less" to the "most" or vice versa, can equally be applied to the description of any urban structure. In other words, the conceptual model of description presupposes similarities between individual cases, and as such cannot account for any differences between the towns.

There are also differences of other types which can be observed. For example, some towns display several open squares of various sizes

and shapes, such as Wargla, Susa or Constantine; while in towns like Algiers or Meknes, there is hardly any open square. In some towns, there are large gardens (i.e., Fez); others include within their walls cemeteries as in Sale or Tunis. Differences in the number, types and location of public facilities can be also noticed between the towns. In capital towns such as Tunis, Algiers or Fez, in addition to the great mosque and the numerous specialized market streets, there are several other facilities, namely public baths, colleges, government courts, palaces, hotels (foundouqs), warehouses. While, other towns accommodate more specific facilities such as the large monasteries in Susa and Guemar.

As Chapter One has shown, some studies have also considered the relevance of environmental factors such as climate or topography (i.e., Fathy H., 1973, p. 320) in the moulding of the Arab city form; while others promoted the belief of interactions of all factors (i.e. climate, topography, socio-cultural factors) as influential in the determination of the urban form. These attempts, whatever the specific determinant of form acknowledged, seem simplistic in so far as they attribute form to external forces, failing thus to consider the complexity of the nature of the urban form itself in purely spatial terms.

One cannot deny the impact of environmental factors in the process of building, but to consider these alone as the main driving forces in the determination of the city form makes it difficult to explain why for example, great variations in the spatial configurations of some towns like Wargla and Guemar or Fez and Sale occur, while both groups are located in regions with the same general climatic conditions. The

examination of the sample of the towns under study shows not only clear variations in the grid pattern of towns within the same region, but also some apparent similarities between cases from regions characterized by opposite climatic conditions. For example, coastal towns such as Tunis or Susa, present some similarities to Saharan towns such as Wargla or Kairwan, in that they are all fortified towns with densely built courtyard houses, they all present a highly deformed street system with many blind alleys. Whereas Saharan towns such as Wargla, Guemar and Tamelhat, although all sited in a region with the same hot climate, present nevertheless strong differences in their overall grid pattern, as Guemar and Tamelhat display a very regular street network which is far from being the case of Wargla. This by itself leads to question the environmental determinist approach and suggests that perhaps other factors, more internal to the form may be at work.

The towns have also displayed morphological differences and similarities inspite of some variation or similarities in the topography of their terrain. For example, it seems difficult to isolate the influence of topography on the overall street configuration when looking at towns all built on an even site such as Wargla, Sale or Kairwan and Guemar or Tamelhat but yet presenting striking differences with regard to their overall street pattern. More puzzling are the similarities observed in the overall street configuration of towns built on high grounds (i.e., Susa); towns built on a gentle slope such as Tunis; and towns built on flat sites such as Kairwan or Wargla.

Against this background, it appears rather limiting to attempt to explain urban forms in terms of external factors whether topography, climate, religion or function. None of these factors seem to provide a fully adequate explanation as a great variety in space structuring can result from seemingly similar causes and similar spatial patterns seem to rise from apparently different causes.

Clearly, the review of past studies on physical form of Arab towns showed that certain hazards of methods exist in the adopted approaches. The fundamental problem seems to lie in the difficulty to extract or derive objectively, evidence for either similarity or difference from the description of these systems. In this respect, Popper suggests that such evidence can be seen as objective if it is derived from the essence of the object. He writes that "if we can explain the behaviour of a thing in terms of its essence, of its essential properties, then no further questions can be raised and none need to be raised (Popper K., 1972, p. 80). Evidence is thus defined as objective if its observability is free of individual interpretation, and this is intrinsically linked with the question of theory and method of study.

In view of this question, Popper proposes that the starting point of any kind of problem solving is never experience, but the development of a theory. Popper's conception of a scientific theory relies on the rational method of conjecture and refutation based on the logical possibility of falsification (Popper K., 1972, p. 81). The role of "facts" in science according to Popper, is then to test and to try to refute theories not to try to show that they are right, as one explicable fact sometimes can be enough to bring down even the best

established theory. Therefore the method of conjecture and refutation must be not only part of an objective process, but the process must be rational, in that it invites to describe an attitude which seeks to solve problems through the critical application of logical argument and by using empirical evidence (Popper K., 1966, vol. 2, p. 225). The essence of scientific rigour lies not in how one arrives at theoretical ideas, but in how to test them or more precisely how to try to refute them.

The application of Popper's conceptualization to the theory of architecture and urban planning is far reaching. Firstly, there is a recognition of the descriptive autonomy of spatial structures, that is the primary and main focus of research must be the urban object itself. Secondly and according to Hillier, there is a requirement for a theory of description with analytical tools, capable of discerning in a systematic way, similarities and differences between individual cases; and in doing so there is a decisive shift from the descriptive approaches which presuppose that urban forms are wholly determined by external forces (Hillier B., 1987, p. 210). Therefore, the problem of description in the process of analysis of urban systems raises questions relating to the explanatory theory, to the model of analysis and the technique of description.

The present study is precisely concerned with the identification and description of various kinds of spatial properties relating to the structure of the urban grid and their possible social implications. In order to do this rigorously in a way which will allow analysis and comparison, it is essential then to resort to a formal and systematic method with theoretically based tools. The syntax theory and

associated methodology for spatial description of urban systems developed by Hillier and Hanson seems most promising. The syntax theory suggests that urban forms can only have lawful relations to social systems if they have in their very form a social component; and social systems can only be lawfully related to space if they already possess their own intrinsic spatial dimension (Hillier B., Hanson J., 1984, p. 26). The main argument of the syntax theory is that the spatial structure of urban forms in general, engenders different patterns of movement and encounter fields, and that the structure of these fields relates to the systems of social relations.

SUMMARY TO CHAPTER TWO:

This chapter has been mainly concerned with the presentation of historical and descriptive material of Arab towns selected from different geographical locations and different general climatic conditions -that is towns situated on the Mediterranean coast, in the hinterland and in the Sahara desert; towns built on various types of terrain and with variation in their dominant urban function. The description of the urban fabric of the towns is based on old maps before any major urban transformations collected from various sources, but also elaborated, whenever possible, with old traveller's accounts drawn from relevant published material. Using evidence drawn from the visual inspection of town plans, this chapter has shown some limitations within the conceptual framework used in past studies of the physical form of Arab towns.

CHAPTER THREE: SPATIAL CHARACTERISTICS OF TOWN GRID STRUCTURES

The present chapter is concerned with the spatial analysis of the grid structure of the 12 Arab towns and their sub-areas. Chapter One has shown how past studies on the physical form of Arab towns have been dominated by a widespread agreement that these towns present a distinct grid pattern centred on a basic notion of a gradual division into sections and sub-sections, interlinked by a hierarchically organised spatial network. This standard description of Arab towns in a hierarchic aggregative fashion is too generalized to give a satisfactory account on the physical form of Arab towns as a visual inspection of the 12 town plans carried out in Chapter Two has shown variations in the grid pattern of these towns and also in the relation of the key public facilities to the overall grid structure. The main themes that have emerged from past studies on physical form seem to have mainly evolved around: i- the question of how "parts" interlink to form the overall urban form; ii- the street pattern and the overall grid structure; iii- and the question of urban centrality, that is how the key town facilities relate to the structure of the grid. How all these aspects take form in Arab towns remains the primary concern of the ensuing analytic chapters.

TOWN GRID ANALYSIS

In urban studies, it has become a convention to break down the complexity of the urban artefact into three components: the street

plan or layout, architectural style of buildings and land-use or function; each of these is given different emphasis dependent on the particular discipline in the the context of which it occurs. Street plan analysis is the primary concern of this chapter. The layout of a town, the streets themselves, is the most conservative aspect of townscape as it cannot be destroyed and rebuilt as easily as single buildings (Conzen M.R.G., 1960, p.148). According to Martin, the grid of streets constitutes the framework of urbanization which remains the controlling factor of the way we build whether it is artificial, regular, and preconceived or organic, which may either limit or open up new possibilities in the way in which we choose to live (Martin L., 196 , p. 10). There have been very few studies that have developed a "morphological" approach which aims at a precise description of the physical form of towns in terms of abstract properties of topological nature. This is mainly due according to Hillier, to the divergence of approaches and interests, especially those brought by social sciences which showed a strong tendency to retreat from the study of the "urban object", and focus more on the study of functions and human behaviour, using "the urban environment as no more than a background -almost a stage set" (Hillier B., 1987, pp. 207-210).

Morphological studies, which necessarily rely on cartographic evidence, immediately raise the question of method of analysis. This is the one aspect in which comparatively few attempts have been made due according to Garrison, to the lack of development of a general theory and the failure to use quantitative devices (Garrison, 1962, p. 463). As a consequence of this, many studies on town grids have focussed on the formal properties of the grid by simply contrasting formal and regular grid layouts to the more informal

ones. The description of town grid in the light of its geometric arrangement has long generated simplistic classifications, such as the "orthogonal or checker board grid plan" including any layout with rectangular arrangement of streets; the "radial-concentric plan" also including the street layouts with progressive outwards growth from a nucleus; and finally the irregular or unplanned layout in which streets' width are irregular and directions haphazard (i.e., Dickinson R.E., 1950, London). This analysis of the urban grid according to formal properties fairly popular among urban historians, however detailed, remains a mere conventional descriptive shorthand, mainly because these classifying devices are as Hillier puts it "too stringent and over determined with respect to the object to be described" (Hillier B., 1987, p. 207) as rarely a grid pattern of a town falls neatly within the above categories, and as such cannot give a full account of the physical properties of the plan.

On the other hand, Conzen's approach to town plan analysis, although not specifically focussing on the grid analysis, has marked a turn in morphological studies, in that he has attempted to develop some general basic concepts geared precisely towards the physical aspects of urban forms (Conzen M.R.G., 1960). Central to this approach of town plan analysis, is the belief that the process of growth characterized by periods of extension of towns, provides successive identifiable plan elements, which can be isolated and interpreted by reference to the general trend of town development. Conzen adopts, for analytical purposes, the subdivision of the town plan into streets and their arrangement in a street system; and plots and their aggregation in street blocks; and buildings or block plans; which has since become widely accepted. He argues that land-uses and

buildings themselves change with time and are adapted or replaced; but the street layout is not easily reshaped and hence plan is the most permanent aspect of towns and as such requires a historical approach.

Although Conzen's work has provided a major contribution both in concepts and detailed analysis of plan, to claim that a theory of urban morphology has been developed is not justified, as a considerable conceptual gap exists between the isolation of "recurrent phenomena" and the provision of a theoretical basis yielding concepts of general application, which are essential for a project that aims both at a concise description of individual grid patterns, but also at a systematic comparison of a sample of 12 town plans. In this respect, Carter argues that the process of plan analysis developed by Conzen "is essentially historical and provides little of the theory or measurement which are needed to substitute generality for the scholarly study of the unique" (Carter H., 1981, p. 145).

In view of this emphasis, Anderson also adopting a morphological approach to town plan analysis, has attempted to develop a method for the study of urban space. He argues: "we need concepts and techniques for analysis of the physical environment itself... We are encouraged to develop analytic capacities because the most inclusive of these environments, the potential environment is more allied with the physical environment than with any set of behavioural patterns. He starts by an attempt to define the concepts of "global" and "local" scale and proceeds to an "objective" analysis of an urban quarter, using an abstract analytical model (Anderson S., 1978). Anderson's "urban ecology model" appears useful, if not a complex tool for the

analysis of an urban quarter within its physical and social context. But the theoretical background remains limited to answer the questions relating to the global properties of a street system, as his study appears to be preoccupied more with the local aspect of a town, without proper reference to its global implications.

The adoption of quantitative techniques to plan analysis in morphological studies, and the use of various aspects of graph theory to quantify spatial relationships represent an area of investigation which clearly breaks away from the traditional lines of study which are concerned with geometry and historical aspects of the grid features. This view is based on the simple assumption that if the topological structure of a street layout can be reduced to an elemental form, it can then be examined by the techniques used to analyse the structure of networks. The network of city streets is, according to Carter "a line pattern, par excellence, and it would seem that any statistical descriptive device would enable a more relevant and measured comparison of street patterns" (Carter H., 1981, p. 150). But, the problem of systematically reducing a town plan into an elemental form remains the fundamental task.

Millward has attempted to establish a set of measures (*) to describe the properties of town grid and has been able to show that an acceptable level of consistency can be obtained in their application

(*) Millward proposed a large number of measures as devices to describe the properties of town grid, which are: total number of vertices (modes); mean number of edges (routes) at vertices; coefficient of variation of the number of edges and vertices; mean length of edges; coefficient of variation of the mean length of edges; road curvatures (Millward H.A., 1974).

(Millward H.A., 1974). Kansky on his part, proposed to look at the shape of the network by using the concept of diameter, or the shortest distance between the most distant vertices of the plan (Kansky J., 1963, p. 84). Kruger also uses a large number of measures in the analysis of town plan. The urban structure is according to Kruger divided into various levels and the connectivity within and between these levels can be described by means of graph theoretical representation (Kruger M.J.T., Ph.D Thesis, Cambridge, 1977; also in "Environment and Planning B", 1981, p. 57).

What emerges from these studies is that graph theory can be instrumental in the description of spatial relationships, mainly because this discipline is "combinatorial" in nature, dealing with elements and relations between them, and uses a formal and precise language. The present study is precisely concerned with the identification and description of various kinds of relations in the structuring of the grid of the 12 towns, such as the relationship between the local and global aspects of the grid, and the properties of the overall structure of the grid. The descriptive theory of urban space developed by Hillier and Hanson lends itself to the numerical quantification of spatial relationships. However, the development of "syntax" method of town plan analysis, presupposes the solution to the crucial problem of representation, which according to Simon in his "Sciences of the Artificial" is a fundamental factor in the problem-solving process. He writes:

"We all believe that arithmetic has become easier since Arabic numerals and place notation replaced Roman numerals... All mathematics exhibits in its conclusions only what is already

implicit in its premises... Hence all mathematical derivations can be viewed simply as a change in representation making evident what was previously true but obscure... This view can be extended to all problem-solving. Solving a problem means representing it so as to make the solution transparent. If the problem-solving could actually be solved in these terms, the issue of representation could indeed become central" (Simon A., 1966, pp. 112-114).

Urban space is, par excellence, continuous in nature, and the question that arises is how can a system whose essential property is continuity, be considered both as continuous and as a set of interrelated elements. Hillier and Hanson suggest that "there are at least two necessary representations of urban space, each of which must be considered in its own right" (Hillier B., Hanson J., 1984, p. 90). The first representation of space is termed "convex" or two-dimensional and is arrived at by dividing the urban space into the fewest and fattest convex segments essentially maximizing area/perimeter ratio. The second representation is the axial or one-dimensional representation of the street layout which is arrived at by drawing the fewest and longest lines in order to cover all of the street system (ibid, pp. 90-91).

From a methodological point of view, the syntax theory proposes a model for the description of settlements with intrinsically "built-in" social dimensions. For example, the social component in space organisation is expressed in terms of some elementary spatial properties, which are associated with the notions of social category and control. These are the concepts of "symmetry and

distributedness" (Hillier B., Hanson J., 1984, p. 62 and p. 94). Symmetry is used in the formal mathematical sense and expresses the relation between two spaces, A to B, as being the same as the relation of B to A, then this relation is said to be symmetric. For example, if A is the neighbour of B, then B must be the neighbour of A, if the relation is to be symmetric. Conversely, if A contains B, then B cannot contain A. The syntax theory suggests that this property introduces differentiation between social categories. A more asymmetric space with respect to others is more remote and distant from the rest, and the occupant of such a space is more spatially removed as more intervening spaces need to be passed through in order to reach it. Asymmetry in space configuration refers to the distancing rather than the integration of space. Therefore a very categoric social system would require more asymmetric spatial realizations.

On the other hand, a relation between two spaces A and B is said to be distributed, if there is more than one independent route from A to B. Conversely, it is non-distributed if there is only one route from A to B. The distributed/non-distributed property of space refers then to the amount of control of a system. A distributed system is one in which control is diffused, whereas a non-distributed system is a system in which control is more localized and unified in a single element, such as the boundary of a building. The theory argues that the very act of creating a boundary is also a social act of realizing a control. As such, the notion of a boundary introduces a distinction between those who live inside the bounded space, the inhabitants, and those who do not and would require specific reason to enter it, the strangers or the visitors.

These two properties are generalized through the notions of integration and segregation (symmetry-asymmetry) and choice (control). The integration and segregation of spaces expresses the spatial differentiation between their users; whilst the provision of alternative routes (i.e., choices) for the transition from one space to another or the restrictions and limitations of such choices, define the forms of spatial control imposed on the users. These fundamental syntactic properties can be captured, as will be seen in the following section, and quantified through a number of spatial measures derived for this purpose. The spatial systems will be then described in terms of their degree of integration and separation and the amount of choice that are prevalent in their configurations.

RESEARCH METHOD AND ANALYTICAL MEASURES:

The present study has adopted the syntax theory and method to investigate the questions raised earlier, that is i- how the local aspects of the grid elements relate to the overall grid structure, ii- how to characterize the structure of the town grids. The syntax model of space analysis considers any settlement, whatever its size, as a bipolar system with the area surrounding the settlement defined as the carrier at one pole, and the buildings at the other. This would correspond in the case of the walled towns under study, to the area beyond the city walls; while the opposite pole would correspond to the built-up fabric contained within the walls. From a sociological point of view, the outside would refer to the domain of the "strangers", and the buildings to the domain of the inhabitants. The open space system, the street network, is then seen as the domain of

interface between not only the inhabitants of the settlement themselves, but also between the inhabitants and the strangers. It is by examining therefore, the open space structure that the spatial characteristics of the realization of these two types of interface can be described.

The street network is considered in terms of its uni-dimensional organisation and represented as a pattern of axial lines. This representation of the open system refers to the maximum extension of a space and therefore may be seen to relate to the global organisation of the system (Hillier B., Hanson J., 1984, p. 90). An axial representation of a system will be then the fewest and longest lines that can be drawn in order to cover all of the open system of the settlement (Ibid, pp. 90-91). The syntax method proposes also a convex representation of the plans in which the open system is in this case, shown in terms of its two-dimensional organisation. A convex map of a town would be then the least number of convex or "fat" spaces that can be drawn to cover the open system. This graphic representation refers to the local variation of "fatness" of the open system and as such may be seen to relate more to the local organisation of the settlement (Hillier B., Hanson J., 1984, pp. 90-91). Because this study is specifically concerned with the uni-dimensional properties of the grid elements at both, local and global level, only axial analysis of the towns has been used (*).

One of the objectives of the following sections is to arrive at a clear characterization of the grid structure of Arab towns through a

(*) Town plans at an appropriate scale (at least 1:1000 scale) are necessary for a precise and fruitful convex analysis of a settlement.

systematic description of the local and global aspects of the axial grid elements and how these two levels relate to each other. For this purpose, two sets of measures have been selected. The first describes the local properties of urban systems, in the sense that only properties directly relating to the individual elements of the axial grid structure are accounted for; the second describes the global properties of the grid, in that, the measures indicate the importance of the individual grid element with respect to the axial system as a whole. The relationship between these two sets of measures is expressed through parametric correlation coefficients. Each of these measures will be briefly introduced in the following.

The most basic of the measures is the connectivity (CN) which indicates the number of other spaces, a given element (i.e., an axial line) of the grid is connected to. The mean CN expresses then the average connectivity of an overall urban system or even of a family of towns. On the other hand, the control value (CV) of a space measures the degree of choice it represents for all of its immediate neighbours. In other words, it expresses the degree to which a given space controls access to its immediate neighbours (SERC Report, 1986, p. 5; Hillier B. et al., 1987, p. 237).

The real relative asymmetry (RRA) or integration measures the number of axial steps a given space is away from every other space in the axial structure of the town grid. Radius-3 integration expresses then the number of spaces, a given space is away from all other spaces that are found up to three axial steps away. Radius-3 integration, by contrast to the global integration (RRA) expresses therefore, the importance of a space at only a local level of

organisation. The average RRA value of an urban system would indicate, for low RRA values, highly integrated systems, and for high RRA values, segregated systems. Similarly, the set of spaces (usually 10% of the total number of axial lines) with the lowest RRA values, represents the 10% most integrated spaces and form the integration core of the street system. The "core" area of an urban system corresponds then, to an area which can be reached from all other spaces of the system by passing through only a minimum number of intervening spaces; that is to say an area where fewer intervening spaces and changes in direction are required from all other parts of the system to reach it. By this, the core area might be seen to draw movement through it to a greater degree than others. Empirical studies at Unit of Architectural Studies have shown a strong relation between integration and observed movements and concluded that the core area of an urban system is therefore an area which likely tends indeed to attract the highest levels of movement and occupancy (SERC Report, 1986, pp. 41-42; Hillier B. et al., 1987, p. 237). On the other hand, the degree to which the area of the integration core relates to the edges of the settlement would indicate the easiness or the difficulty of the accessibility of strangers. A core which approximates a "deformed-wheel" shape, that is with some central spaces (the "hub") and "spokes" linking to the edges (the "rim") in several directions, would be held as geared more towards facilitating the accessing of strangers (SERC Report, 1986, pp. 16-17; Hillier B. et al., 1987).

The choice (CH) measure expresses the degree of choice that a space represents on all shortest routes from all spaces to all other spaces in the system (SERC Report, 1986, p. 5). This measure indicates the

degree to which every line of the grid is likely to figure on simplest path journeys from each node to every other node in the network and therefore predicts the amount of choice that each space contributes to the system as a whole. The measure of choice, as such appears to be more difficult to "intuit", mainly because it requires a mental map of the system not only in terms of the number of steps and changes of direction separating spaces from each other, but also of all the possible routes between spaces and as such can be seen to be more likely representing the movements of the inhabitants (SERC report, 1986, pp. 6-7). On the other hand, the measure of integration, appears as a more "intuitive property, in the sense that an intuitive picture of the system can be built fairly easily when gradually moving about the system" (SERC report, 1986, pp. 6-7). This measure can be seen then to be more likely related with the movements of strangers in the system. However, this is only conjecture. Research has shown consistently that the measure of integration applied to the axial map is the best overall predictor of movement (ibid, pp. 31-40).

The investigation of the patterns of random journeys of random length from the "gatelines" (i.e., axial lines that run through the town gates) is also carried out for each town, and the resulting quantities are correlated with the choice's. The model also suggests higher order measures derived from the statistical relationships or the degree of agreement between the four basic measures; and these are also aimed at a further characterization of the grid structure. For example, the intelligibility of urban systems is defined as the correlation between the global measure of integration (RRA) and the local measure of connectivity (CN). This measure expresses the degree to which the large scale structure of an urban system can be

inferred from the information derived from the local properties of space (ibid, p. 6). A relative value of this measure, referred to as relative intelligibility, is computed for each town by reference to the expected intelligibility predicted by the synoptic studies of the 75 urban systems for systems of similar size (SERC Report, 1986, p. 17). The correlation between the integration and choice referred as the "movement interface" (*) expresses the degree of agreement between the accessibility of a space as a "destination from all other spaces in the system and its attractiveness for through movements to more remote spaces" (SERC report, 1986, p. 6). In other words, this measure indicates the degree to which the dynamic dimension of a system might be predicted from its global structure; or if the "inhabitants-strangers" conjecture previously referred to were true, to the degree of interface between inhabitants and strangers. The interface of inhabitants and strangers is also explored through the correlation between choice which could be seen to represent the theoretical movements of the inhabitants, and the random journeys from the outside of the town representing the theoretical movements of strangers.

Similarly, the degree of agreement between CN and CH, referred to as local predictability, indicates the degree to which the choice paths in the system can be predicted this time from the connectivity of a space alone. While, the degree of agreement between the control value (CV) and choice (CH) referred to as the interface potential

(*) Similarly to intelligibility, a relative value of movement interface is computed on the basis of the value predicted by the synoptic studies of the 75 urban systems for systems of similar size (ibid, p. 6).

expresses the degree of choice a space represents at a global level can be predicted from the degree of control it represents to its immediate neighbours (*ibid*, p. 6).

The syntax model for the analysis of urban systems includes many other measures and only those selected to tackle the questions under investigation have been described above. However, it seems appropriate to briefly point out two important conclusions obtained from the synoptic studies of the SERC report: i- the results of the application of the syntax model to 75 urban systems and areas by the Unit of Architectural Studies have demonstrated some consistencies in the way in which some of the above spatial properties relate to observed movements. For example, the patterns of movement have been shown to be mainly governed by the integration of the observed systems; ii- the results of the research on urban structures compiled in the SERC report have also shown that the degree to which integration predicts movements in urban systems is strongly governed by their level of intelligibility. In other words, specific relationships between spatial structuring and the functioning of urban systems have been to some extent established (SERC report, 1986, p. 40).

In the light of the above concepts and quantifying devices which deal with the local and global properties of the grid structure, a town-by-town analysis is now carried out on the basis of the axial representation of the system of open space. This will constitute the first part of the present chapter, while the analysis of the towns taken as a group using also the axial representation of the town grid, will form the second part. The analytical results will be then

discussed in a separate chapter. The main objective of the first part is then to identify the overall arrangement of the urban grid in each of the 12 towns through syntactical representation and analysis. In other words, the task assigned to this part is to arrive at a clear characterization of the structure of each of the 12 town grids at both local and global levels of organisation. The second part aims at identifying the prevalent properties which may be considered as distinctive features and may therefore serve as a reference basis to recognize a typical grid of Arab towns.

The strategy adopted for the detailed analysis of each of the town grid can be summarized as follows:

i- a spatial analysis of the grid of the quarters of the towns is carried out in an attempt to identify the prevailing relationship between the organisation of "parts" and the structure of the "whole". The analysis of the urban parts concerns only the towns whose quarters boundaries have been possible to define according to available sources^(*).

ii- a spatial analysis of the properties of the overall grid structure taken as a "whole" is undertaken using the same quantifying devices. This is simultaneously carried out through a systematic examination of the behaviour of the spatial properties when two grid elements, the system of dead-ends and the peripheral streets, are alternatively discounted. These grid elements may be thought of more as transitional spaces between on the one hand, the space beyond the

(1) The towns which have been subject to this spatial investigation are Tunis, Algiers, Sale, Constantine, Meknes, Fez and Wargla.

town walls and the built fabric (i.e., the town gates and the peripheral streets), and on the other, the spaces between the street and the houses (i.e., cul-de-sac passages). The basic idea behind this is to assess the individual contribution of these two distinct features of Arab towns often associated with the notion of social control and privacy, in the overall structuring of the town grid. To avoid confusion between the different representations of the urban grid, some abbreviations will be adopted in the following text and in the tables. For example, T.1 in the case of Tunis, will refer to the analysis of the distributed system of the town grid, that is without taking into account the cul-de-sac passages; T.2 will refer to the analysis of street grid of Tunis, including the dead-ends passages; and T.3 will refer to the analysis of the system as in T.1 but with the peripheral streets discounted. Throughout the present chapter, the discussion of the measures is based on the main version, that is the distributed system of the town grids with the peripheral lines.

The analytical procedure adopted in the spatial analysis of each of the 12 town grids aims:

First, i- to examine the properties of the grid at the level of the quarters taken separately in the case of each town, that is the means and distribution of the spatial measures as well as their statistical correlations and see how the quantified properties of the "parts" differ from each other and from those of the "whole".

ii- to examine the grid structure of each quarter in each town, through the study of both the pattern of their respective integrating structures and also the overall pattern resulting from their combination. The combination of the integration cores of the

quarters will be also examined against the pattern of the integration core of the "whole", with the intention to see how "parts" relate to the "whole".

iii- to present a detailed analysis of the numerical properties of each of the 12 town grids and compare the results to those given by both, the analyses of the grid taken with the dead-ends and when the peripheral streets are discounted.

iv- to present a detailed analysis of the various features of the global structure of each of the town grid, that is the identification of the integrating and segregating parts and how they relate to each other. The other two analyses of the town grid are also looked at in this section.

v- to examine the pattern of the system of "choice" paths and the random "journeys" originating from the outside represented as a single space, and the analysis of the degree of agreement between the two spatial measures. This is aimed to explore how the spatial layout is likely to structure the system of choice paths, and see how far this latter correlates with the pattern of random journeys originating from the outside, in an attempt to formulate, on the basis of the previously mentioned conjecture, some hypotheses about the intensity of interface that is likely to take place between the movements of inhabitants that may be seen to correspond to the choice paths and the movements of strangers given by the random journey paths from the outside. It must be noted, of course, that the conclusions of a such analysis can only be speculative as the results are not, within the scope of this thesis, supported by observations of real movements.

PART ONE : TOWN-BY-TOWN ANALYSIS

The spatial measures are generated on the basis of the distributed structure of each of 12 town grids represented in terms of their axial relationships. Axial maps are therefore drawn for each of the towns and reduced versions of these graphs are given in Figure 3.1. This graphic representation shows already great variation that exist with respect to the number of axial grid elements and their arrangements. With 723 and 628 axial lines, Fez and Tunis are by far the largest systems reaching respectively 1590 and 986 with the non-distributed lines. These maps show also no consistent pattern as to the number and location of the longer lines in the overall structure. For example, for towns like Tunis and Wargla, the few longest lines are mainly found in the central part (see also figures 3.2 and 3.54). For Tangier, there is only one dominant long line which penetrates the urban fabric linking the main mosque to the town's gate (see fig. 3.1 and also fig. 3.25). In most of the remaining town grids, the lines of major length tend to develop along the periphery, clearly defining the town's edges, such as the case of for instance Kairwan, Guemar, Tamehat and Susa. By contrast, the axial lines defining the edges of the town grids of Tangier, Constantine, Meknes, Fez and to a lesser extend Algiers and Sale, appear to be more broken up and clearly marked by shorter lines. However, a visual inspection of the 12 axial maps shows that in most of the cases, the long axial routes which link for instance the town mosque to the town gates tend to be defined by lines of predominantly average length and occasionally by few long lines which often interconnect at open angles (see axial maps of Tunis, Algiers, Fez, Tangier, Susa in figure 3.1).

The overall grid structure of Constantine and Fez, hardly displays any line that is markedly predominant in terms of its length; the overall axial arrangement appears to be irregular and clearly more broken up than in other systems (see also fig. 3.30). In three other cases: Sale, Tangier and Algiers, the axial grid structure is characterized by a predominance of short lines. In addition to the irregular overall grid pattern, Fez presents very deep cul-de-sac passages with sharp changes of direction (see also fig. 3.42). The angles defined by the intersection of the axial lines in these systems vary greatly and do not neatly fall in one category. Axial lines in Tangier, the upper part of Algiers, Meknes, Fez, Tunis intersect at more acute angles; while in other systems such as Sale, Susa, Guemar and Tamelhat, or parts of the axial systems such as the eastern part of Wargla, the lower part of Algiers, the lines meet at angles approaching the right angle (see fig. 3.1). The characterization of the grid deformation of the 12 towns constitutes the main concern of the present chapter, using the analytic measures presented earlier.

However, using the elementary measure of grid axiality, a preliminary indication of how deformed a system is by contrast to a regular grid system with the same number of axial lines, can be obtained. The smaller the value of grid axiality is, the more distorted and deformed the grid is. This measure shows that the levels of grid deformation can fall into four groups: Level One (0.0365) is the lowest and includes the town of Fez only; Level Two (0.05) groups the towns of Tunis, Algiers, Tangier and Constantine; Level Three (0.07): Sale, Susa, Meknes, Kairwan, Wargla and Level Four (0.178 and 0.235) the systems of Guemar and Tamelhat (see General Data Table 3.1 below). This characterization, although not very precise mainly because it is



FIG. 3.1: AXIAL MAPS OF
THE 12 TOWNS

not relativized against size, seems fairly consistent with what can be accounted for on the basis of a visual inspection of the axial maps, such that more regularity has been observed in the structure of the axial grid of for instance Guemar and Tameihat than Fez or Tangier (*).

All measures for each town (and their means) derived from the subsequent town-by-town analysis are summarized in the general data table shown below. It shows on the left column two sets of measures: the first set relating to basic morphological characteristics of the town such as the area of the towns within the walls (in hectares), the number and size of urban blocks (in m²), the ratio of the total number of axial lines (K2) and the number of distributed axial lines (K1), number of axial lines per hectare, the mean depth of cul-de-sac passages (MD2) which refers to the average number of steps from a distributed space, that is a line located on a circuit; the second set indicating the syntactical measures described earlier such as the connectivity (CN) and integration (RRA) of each of the 12 axial systems of the towns, the intelligibility including the relative value ($1:RA/CN$), movement interface ($1:RA/RCH$), local predictability (CN/CH) and interface potential (CV/CH). The means of the above measures are shown on the far right column of the table. The measures set in this table will be discussed in details as one proceeds through the analysis of each of the 12 towns, and will also constitute the basis for the ensuing synoptic study presented in the second part of the present chapter.

(*) However, the regularity that could be seen in some parts of the town grid, does not seem to affect the overall grid axially coefficient, which may explain the unexpected result that the grid of Sale appears as distorted as of Meknes.

TABLE 3.1: GENERAL DATA TABLE FOR THE 12 TOWNS

("BLOCKS" refers to the number of blocks; "K1" refers to the number of distributed axial lines and "K2" to the total number of axial lines; MD2 refers to mean depth of the dead-end lines)

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SIZE(m2)	4661	2349	6294	4878	3077	4082	5357	14094	3658	5900	7941	5655	4661	2349	6294	4878	3077	4082	5357	14094	3658	5900	7941	5655	4661	2349	6294	4878	3077	4082	5357	14094	3658	5900	7941	5655																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
LINES/ha	6.097	11.222	3.944	6.375	9.975	5.933	3.443	5.531	8.533	5.566	2.148	7.039	6.097	11.222	3.944	6.375	9.975	5.933	3.443	5.531	8.533	5.566	2.148	7.039	6.097	11.222	3.944	6.375	9.975	5.933	3.443	5.531	8.533	5.566	2.148	7.039																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
K1	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	267	723	271	256	59	341	628	505	355	255	314	399	2

THE TOWN OF TUNIS

With 628 axial lines of the distributed system and 986 including the non-distributed, the town of Tunis stands as the second largest system of the 12 towns. The main characteristic feature of the axial structure is the predominance of relatively short axial lines all over the town surface, which tend to inter-connect in many parts at open angles. The map in Figure 3.2 (*) shows a concentration of short lines which intersect at much sharper angles in the eastern and southern part of the town. The 24 peripheral lines which connect the 7 gatelines are relatively long. The map also shows lines of average length intersecting at open angles, developing almost parallel to the eastern edge. In addition to this route, other axial internal routes also defined by lines of relatively average length and always intersecting at open angles, run from the town's gates towards the central part of the system (i.e., the trading centre in the heart of which stands the great mosque). The axial organisation displays a large number of dead-end passages of various depth of the dead-end lines from the distributed lines is 1.5447. The axial system of Tunis is divided up into 9 sub-systems of various sizes, corresponding to the quarters. Two of the small sub-areas occupy the central part of the system; while the 7 remaining are along the periphery, each with one town gate.

(*) The illustrative figures referred to in the text are inserted at the end of the analytical section of each town.

THE QUARTERS OF TUNIS:

Table 3.2 sets up the first and second order measures of the quarters taken separately and the town as a whole. The results show that the mean connectivity of the 9 quarters tends to approach the mean connectivity of the town as whole without however exceeding it, except for QT6 (2.833) and QT9 (2.738) where it is well below it. The maximum connectivity of the quarters varies but not strongly (from 6 to 9 with an average of 8) and does not increase markedly in the whole system (9.00). The table shows also a fairly similar level of integration for the 9 quarters (varies from 1.0476 to 1.200), which remains in all cases high compared to the mean integration of the town taken as a whole (1.2982). The maximum segregation (max. RRA) of the quarters varies considerably when compared to each other and to the whole town. Two obvious features are already prominent from the data table which are firstly: how strongly consistent the parts are in Tunis (especially the mean integration); and secondly: how consistently the whole is a little less integrated than its parts (the mean integration of quarters being 1.1326 by contrast to 1.298 for the whole).

The second order measures of the quarters shows also differences by contrast to the town as a whole. The mean of the relative intelligibility of the quarters (-0.074) is lower than the relative intelligibility of the town as a whole (-0.005), suggesting then the existence of a "super-grid" structure in this town. The mean (relative) movement interface for the 9 quarters (-0.081) is also low compared to the town as a whole (+0.057). On the other hand, the quarters of Tunis appear more predictable locally than the town taken

TABLE 3.2 : MEASURES FOR THE QUARTERS OF TUNIS AND TUNIS TOWN (VERSION 1)

	T.1	Q.T.1	FRANCIS	HARA	Q.T.2	SEBAGIN	AZAFINE	Q.T.4	SUKEBLAT	Q.T.5	MEHREZ	BEYLIC	Q.T.7	BEY	Q.T.8	ACHOUR	Q.T.9	MEAN
NUMBER OF	628	149	106	90	60	61	60	60	60	91	60	65	82.44					
MEAN CN	3.341	3.168	3.189	3.000	3.067	3.115	2.833	3.253	3.100	2.739	3.051	7.444						
MAX. CN	9.000	8.000	8.000	8.000	8.000	8.000	8.000	9.000	8.000	8.000	8.000	7.000						
MEAN RRA	1.298	1.200	1.145	1.104	1.138	1.048	1.183	1.089	1.102	1.185	1.132							
MAX. RRA	1.780	1.850	1.690	1.700	1.590	1.620	1.830	1.540	1.780	1.640	1.693							
MIN. RRA	0.900	0.770	0.700	0.680	0.730	0.580	0.740	0.745	0.740	0.670	0.706							
ST.DEV.	0.178	0.206	0.224	0.219	0.215	0.246	0.253	0.166	0.244	0.228	-							
1:RA/CN	0.490	0.560	0.610	0.480	0.750	0.640	0.720	0.560	0.770	0.630	0.635							
REL	-0.005	-0.091	-0.073	-0.218	+0.017	-0.092	-0.013	-0.137	+0.037	-0.096	-0.074							
1:RA/RCH	0.610	0.680	0.720	0.680	0.820	0.750	0.660	0.740	0.540	0.780	0.707							
REL	+0.057	-0.253	-0.017	-0.071	+0.033	-0.035	-0.127	-0.011	-0.247	+0.0001	-0.081							
CN/CH	0.630	0.730	0.750	0.700	0.780	0.810	0.720	0.680	0.660	0.780	0.734							
CV/CH	0.460	0.540	0.570	0.670	0.490	0.730	0.550	0.590	0.600	0.670	0.601							

as a whole as could be seen from the mean local predictability (CN/CH) of the 9 quarters (0.734). Similarly, the interface potential (CV/CH) of the small systems is stronger (mean=0.601) than the whole, but also varies from one quarter to the other.

The integration cores (1*) of the quarters of Tunis in Figure 3.3 have some common features with respect to the overall shape and location within their respective sites. Most of the cores form a linear structure traversing the quarters and to which connect several other lines running in various directions. The integration core of "Beylic" quarter (see fig. 3.3), unlike the others forms a large ring joining opposite edges of the quarter. The cores seem to avoid the lines dividing the quarters, except in the centre.

The examination of the integration maps of the quarters suggest one common characteristic, that is most of the cores of the small systems cover the fabric of the quarter only poorly. Moreover, the cores not only have a similar internal structure, but also they almost link to one another to form a global system.

Some preliminary conclusions can be already drawn from the above results that is, when Tunis taken as a whole, it has consistently maintained the mean integration and maximum connectivity relatively low. The second result is that the system, when taken as a whole, does not increase substantially its maximum connectivity, which may explain the slight increase in the level of segregation of the town.

(1*) Throughout this study, the integration core represents the 10% of the most integrated spaces of a system.

That is, the system seems to grow by adding more elements without adding more order to control the effect of growth. But, it has been seen that the system when taken as a whole, becomes more intelligible, less locally predictable but develops a better movement interface than its parts. If this is so, what are then the spatial means by which this system increases its intelligibility and movement interface as it becomes larger? The slight increase of the mean connectivity suggests that the system, as it grows develops more lines with a higher number of connections but without exceeding the maximum connectivity. The fact that the relative intelligibility of the system also improves suggests that these highly connected lines of the sub-areas might inter-link so as to form a kind of a "super-grid" defining these local parts. The structure of the local cores and the way in which they tend to link to form a global and more covering pattern lends support to this suggestion.

SPATIAL PROPERTIES OF THE WHOLE SYSTEM:

The results of the analysis of the grid of Tunis are set up in Table 3.3:

The mean connectivity of Tunis as a whole is about average by reference to the 75 urban systems (3.595), except for the system taken with the dead-ends (T.2) where it decreases to 2.998, and the maximum connectivity increases only when the town is looked at with the dead-end spaces, otherwise remaining constant and below average in all other versions (9.00).

	T1	T2	T3 (*)
K	628	986	605
MEAN CN	3.3408	2.998	3.2661
MAX CN	9.000	13.00	9.000
MEAN RRA	1.2982	1.3077	1.4192
MAX RRA	1.7800	2.2164	2.1700
MIN RRA	0.9000	0.8880	0.9300
ST.DEV.(RRA)	0.1776	0.1921	0.2271
1:RA/CN	0.4900	0.4900	0.4600
REL INTELL	-.0050	+.0547	-.0400
1:RA/RCH	0.6100	0.5700	0.5200
REL	+.0571	+.0745	-.0373
CN/CH	0.6300	0.6500	0.6500
CV/CH	0.4600	0.4800	0.4400

TABLE 3.3: FIRST AND SECOND ORDER MEASURES
FOR TUNIS

On the other hand, the mean integration is in all versions of analysis, well below average (0.9337), and remains fairly constant in the system looked at with and without the dead-end spaces (T.1 and T.2),

(*) T.1 refers to the town analysed without the cul-de-sacs, that is the distributed spaces only; T.2 refers to the system as a whole including the cul-de-sacs; T.3 refers to the system considered without the peripheral streets. An analysis has been conducted on the system with the gatelines connected to the outside considered as a single, which came out in all towns by far as the best integrator and resulted in a great distortion of the integration measure and the structure of the core.

suggesting then that the dead-ends do not seem to have much influence on the overall level of integration. However, the removal of the connections of the town grid to the peripheral streets (T.3) does result in a marked loss in the integration of the system. The maximum segregation (MAX. RRA) increases strongly in both, the system looked at with the dead-end spaces (T.2) and without the peripheral streets (T.3).

The intelligibility (1:RA/CN) of Tunis appears low, but the relative intelligibility is average and improves when the dead-ends are added to the system (T.2), suggesting perhaps a distinct characteristic in the spatial structuring of this town. The movement interface (1:RA/RCH) of Tunis is also low; but, when the relative value appears average. The local predictability (CN/CH) and interface potential (CV/CH) vary little according to the different versions and remain much below average (0.7675 and 0.6789).

Figure 3.4 shows the integration core (5 and 10%) and the segregated spaces (50%) of the town (version T1). The first and second integrators run adjacently to the great mosque along the market streets (see figures 3.2 and 3.4). The 3rd to the 8th most integrated spaces all lie on the market streets, while the 9th most integrated line links the core to the sovereign's palace (Dar El Bey) and to the citadel located outside the town walls. The few lines running along the peripheral streets are among the least integrated spaces of the core. The core forms a dense structure developing east-west in the central part of the city, with fewer lines running north-south where the main market streets are located. The core links directly to the periphery and to the outside on the seaside. The most segregated

spaces form four distinct large dense clusters on either side of the core. They form the densest structure in "Francis" (Q.T.1) and "Sebagin" (Q.T.3) quarters located on the eastern edge of the town.

When the dead-end spaces (or the non-distributed) are taken into account in the analysis of the town grid, the overall pattern and location of the integration core remains largely similar to the previous version (T.1). The most integrated spaces remain in the vicinity of the great mosque. The core includes also many dead-ends, indicating a strongly localised structure (see fig. 3.5a). Similarly to the previous case (T.1), the segregated spaces form mainly two dense clusters, one on the eastern side of the core, the other on the southwestern edge of the town. The segregated dead-ends represent about 74% of the total number of the non-distributed spaces in the system.

When the peripheral streets are not taken into account, the core retains its overall shape and location in the urban fabric, but presents some differences in terms of order of integration of the spaces, compared to the system in T.1 (see fig. 3.5b). In this case also (T.3), the spaces adjoining the great mosque remain the two best integrators, as much as the 3rd and the 4th which also keep the same order. The differences between the cores of T.1 and T.3 reside in the fact that first, the palace and the citadel become much less integrated showing therefore their dependence on the connections of the town to the edges for their integration; and second, the town becomes less strongly connected to the outside, that is the core compresses more into the central area suggesting that the only integrated accessway to the town also depends on the periphery for its integration. The most segregated spaces form as in T.1 separate

clusters on either side of the core, expanding only along the north-eastern and southern edges of the town.

The analysis of radius-3 integration indicates that radius-3 core (*) includes many spaces of the global core of the town and runs orthogonally to it. But, radius-3 core shifts more decisively towards the interior of the fabric and tends to cover the whole town (see fig. 3.6). However, radius-3 core includes also some spaces (in fact only 4 lines) that are segregated in the global structure, but strongly overlaps with radius-n core at the central area of the market streets and the great mosque. On the other hand, the comparison of radius-3 core of the town as a whole and the combined core (*) shows that every quarter has at least one line in common with radius-3 core (see fig. 3.3), indicating a key characteristic in the way in which the local parts relate to the global structure of the system. In other words, the covering type of structure of radius-3 core seems to act as a kind of a liaison between on the one hand the parts of the system and on the other, between the parts and the whole. Moreover, the cores of the parts tend to link to form a global structure with a strong bias against the run of the overall core. Both, the more covering structure of radius-3 core and the structure of the combined core lend support of the idea suggested earlier; that is the town of Tunis when taken as a whole, seems to develop more lines with higher connections without exceeding the maximum limit (MAX. CN=9), which tend to inter-link to form a "super-grid" effect defining the local areas. The

(*) The number of lines constituting the radius-3 integration core equals that of radius-n as in version T1.

(*) The combined core is constituted by the integration cores of the quarters analysed separately.

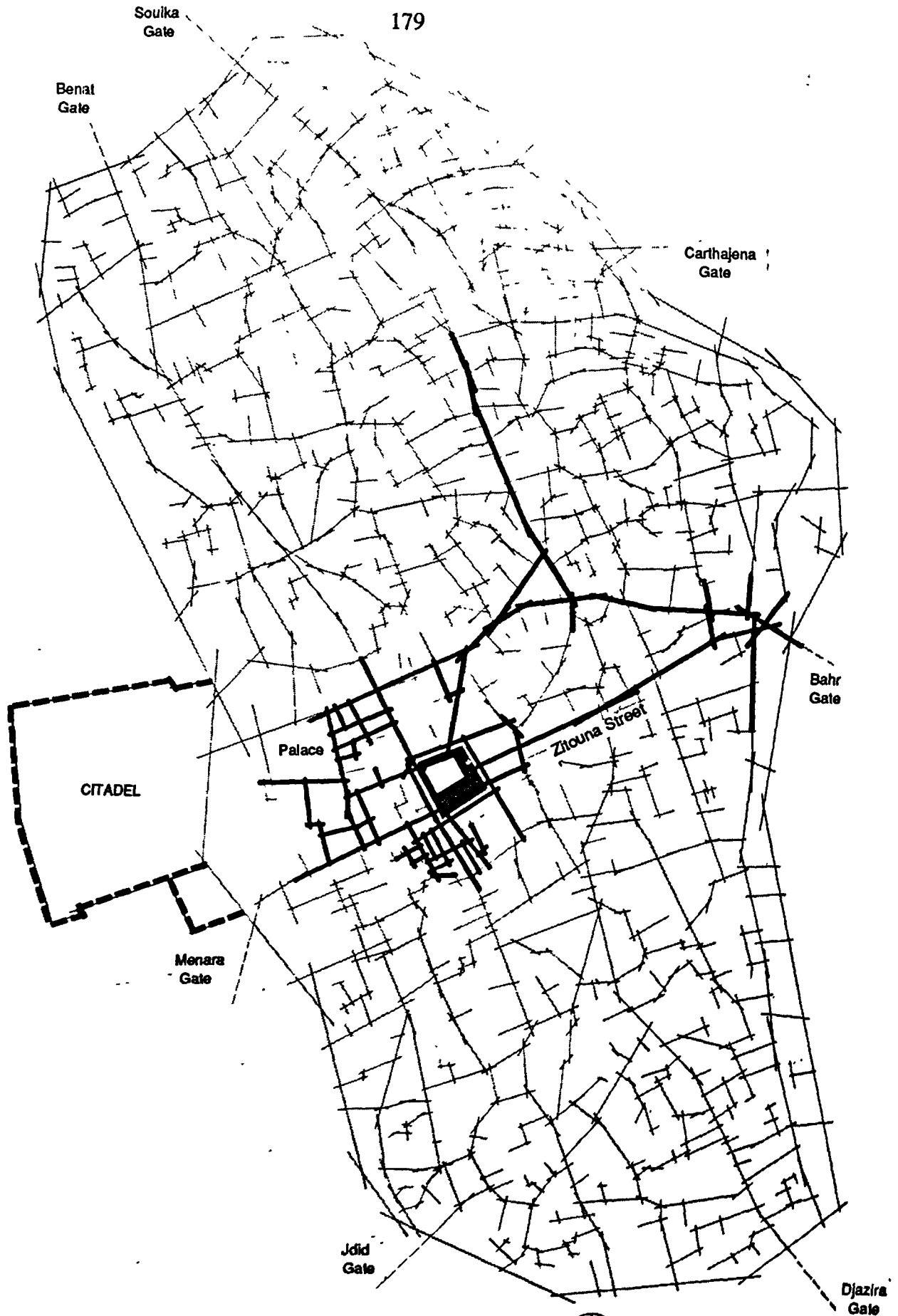
effect of this would be, it is suggested, to improve but not markedly, the mean connectivity and the intelligibility of the system without however increasing its maximum connectivity, and to maintain the overall level of integration close to that of the parts.

Figure 3.7a shows the strong spaces in terms of choice and the random journeys from the outside (*). The strong choice spaces form one structure running from the central part towards the northern and eastern gates, without however linking to the outside; but also a discontinuous cluster south of the mosque. Most of these spaces develop along the market streets and around the great mosque which is the second strongest choice space. Only two lines develop along the periphery. The strong choice spaces of the town without the peripheral streets (see fig. 3.7b) present a linear structure developing north-south across the great mosque which becomes in this case the strongest line in terms of choice. The choice structure in both T.1 and T.3 do not present strong differences.

The simulation of random journeys from the outside and its comparison to the choice quantities shows a correlation of 0.5129. But the examination of the graphic representation illustrating the distribution of these quantities (see scattergram in Appendix 2) reveals no clear pattern, suggesting therefore a weak interface between the two spatial measures of choice and random journeys from the outside.

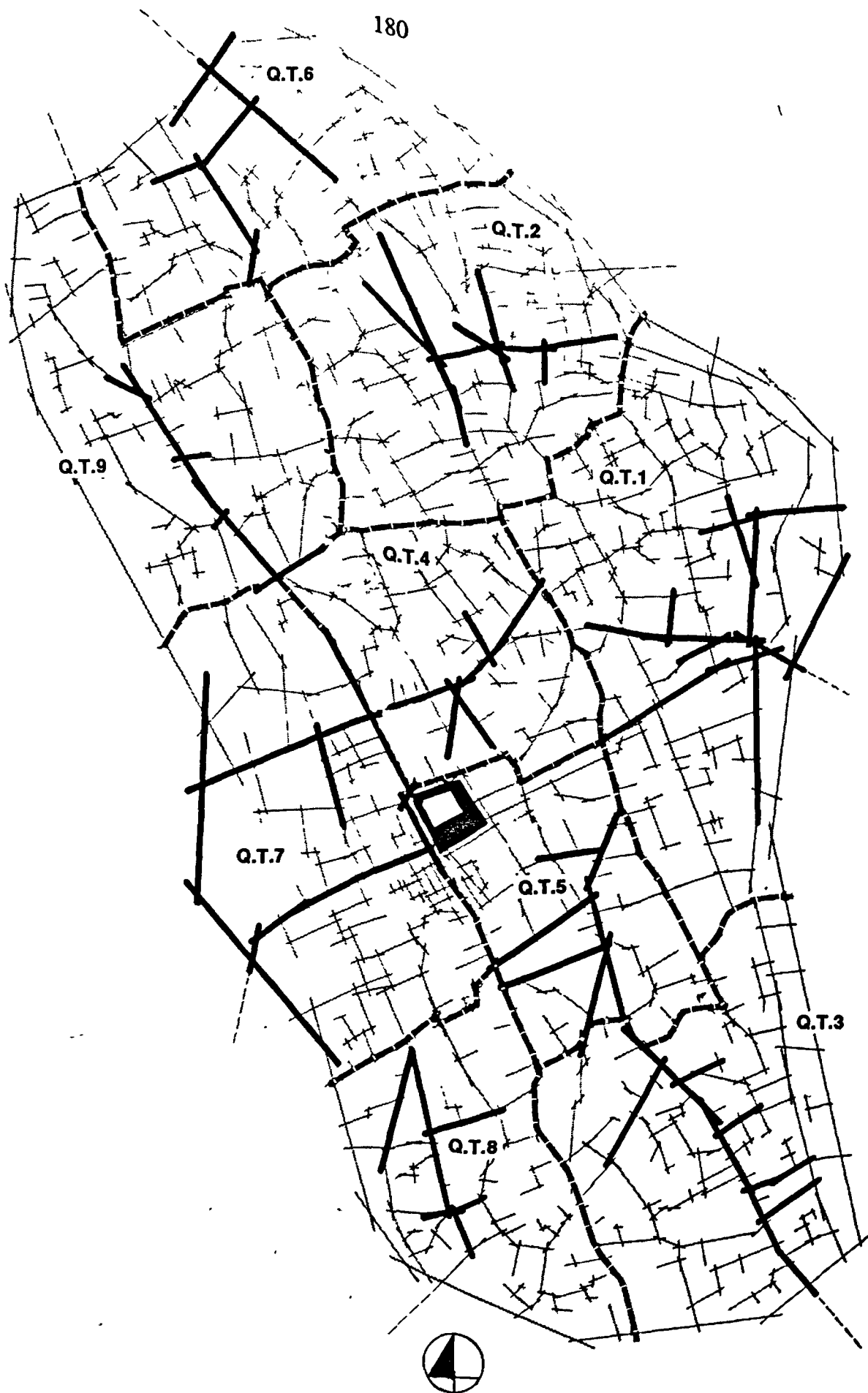
(*) The strong choice lines constitute 25% of the choice quantities and a similar number is taken for the random journeys from the outside.

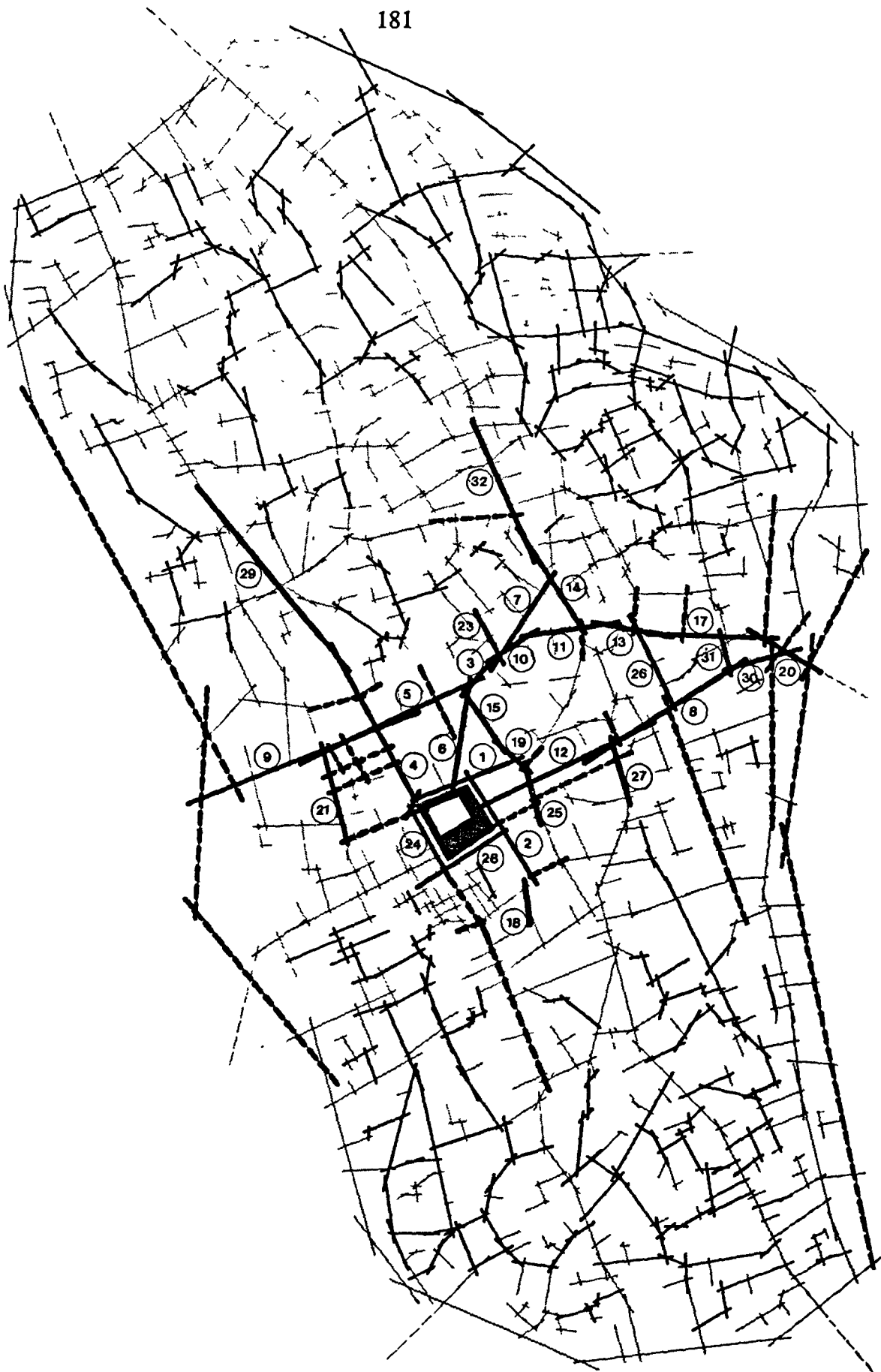
The above results clearly indicate that the low level of integration of the system of Tunis is not the result of the dead-end structure; but the peripheral streets seem to contribute to a certain extent, to the integration, intelligibility and movement interface of the whole town. In conclusion, the grid of Tunis can be characterized by: i- a compressed global core around the great mosque/market area, but essentially linear, linking one entry (citadel) to the opposite one via a semi-grid of maximum integration lines in the centre; ii- a strong local structure; iii- a radius-3 core which links local cores into an overall structure which covers much more and almost tends to form a deformed-wheel core; iv- the structure of radius-3 core seems to be the key in relating parts to the whole.



TUNIS

FIG. 3.2: AXIAL MAP
Market Streets

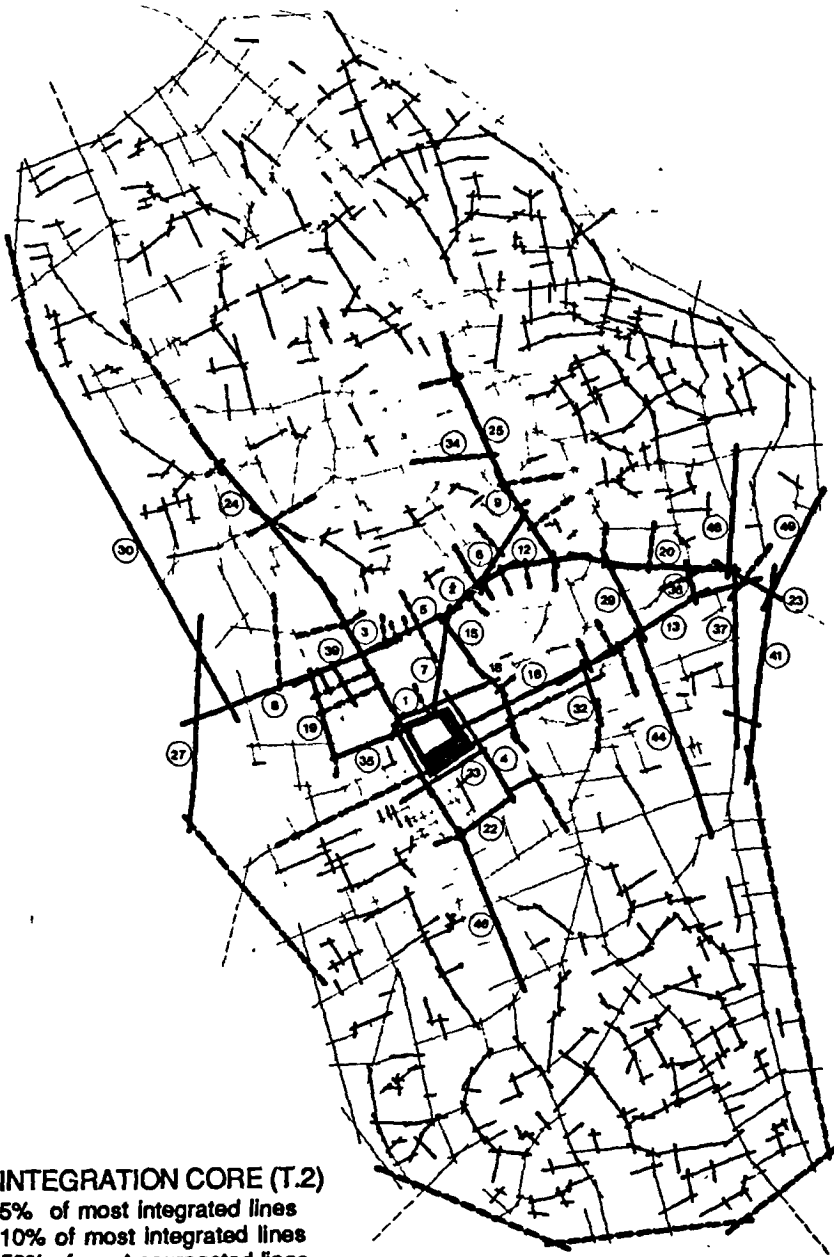
**TUNIS****FIG. 3.3:****INTEGRATION CORES (QUARTERS)**
10% of most integrated lines



TUNIS

FIG. 3.4: INTEGRATION CORE (T.1)

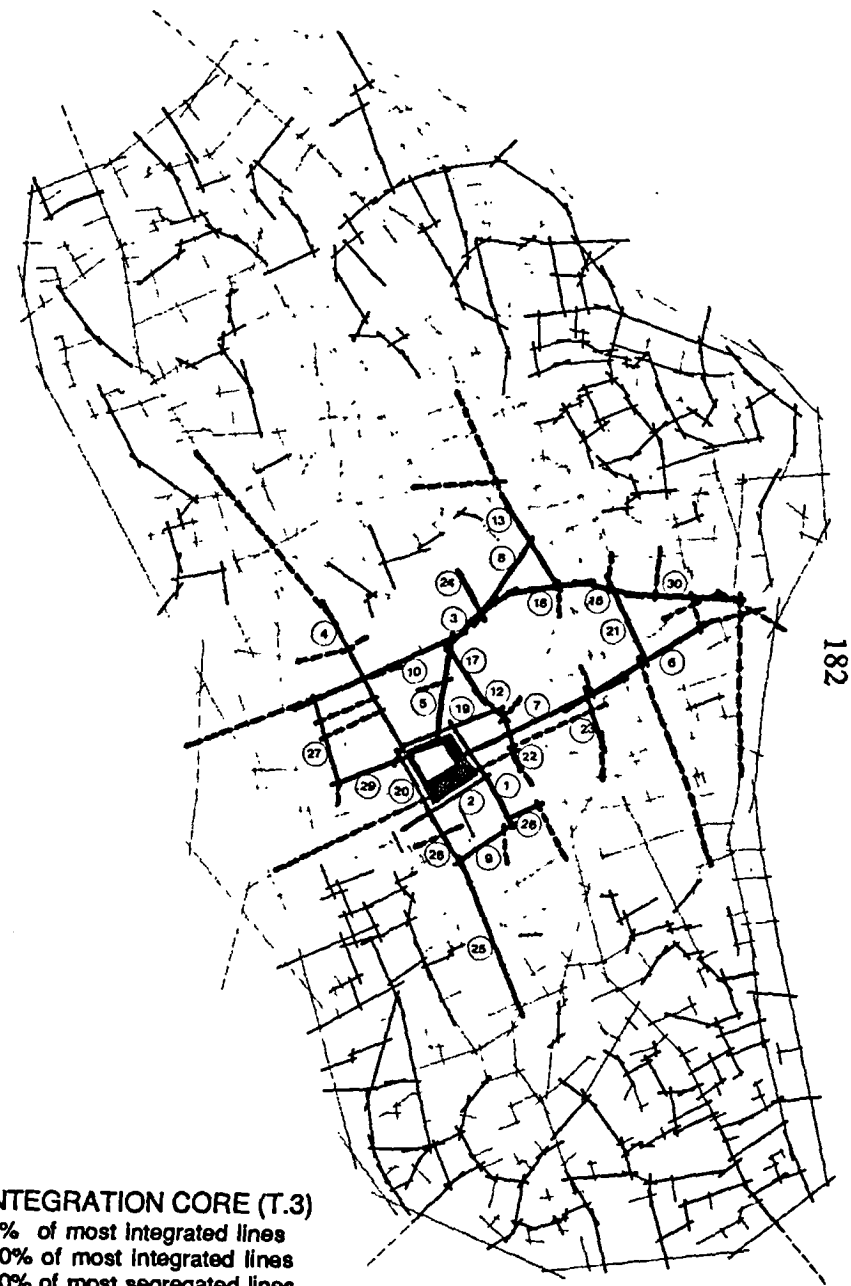
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



TUNIS

FIG. 3.5a: INTEGRATION CORE (T.2)

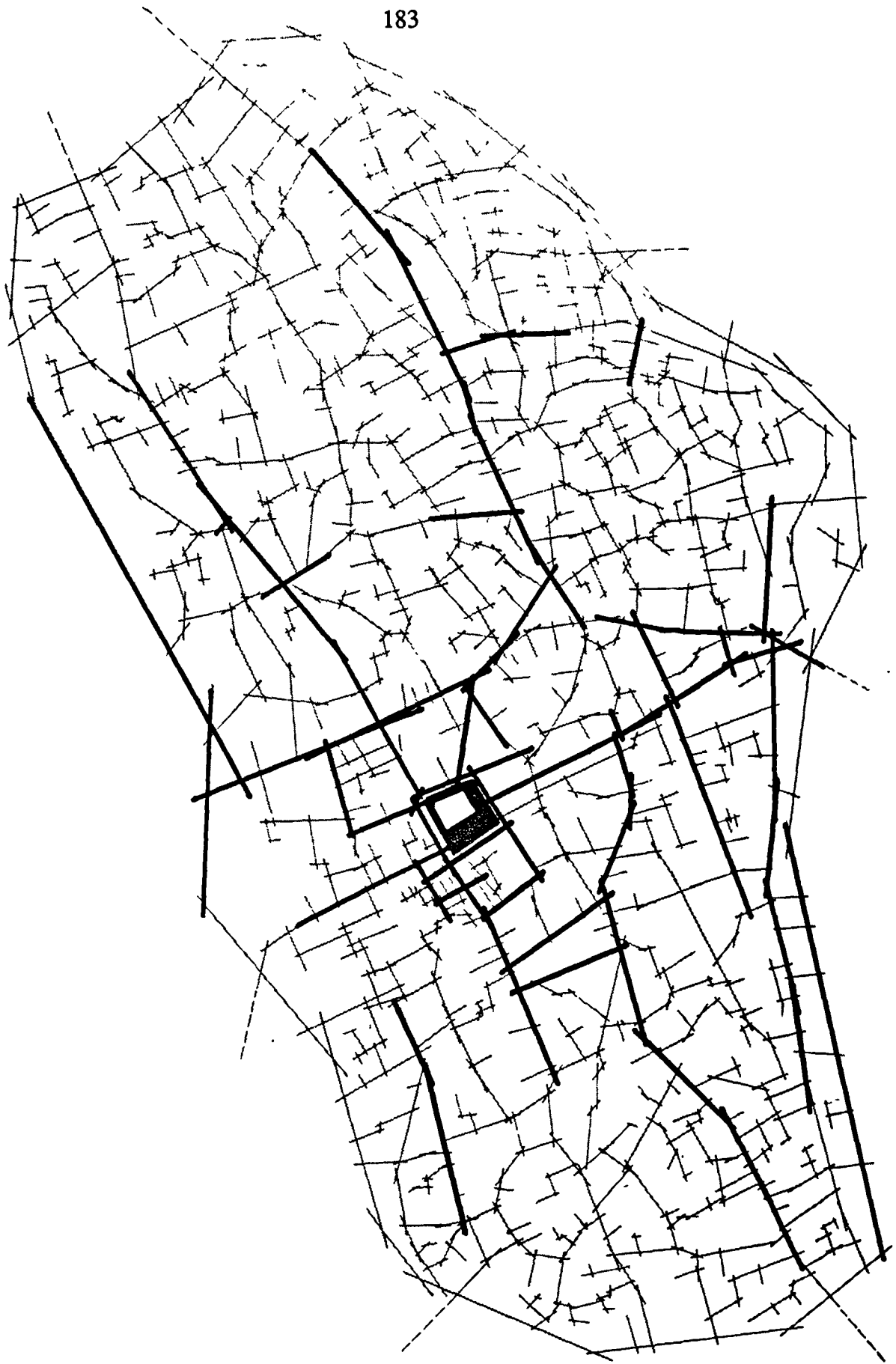
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



TUNIS

FIG. 3.5b: INTEGRATION CORE (T.3)

- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



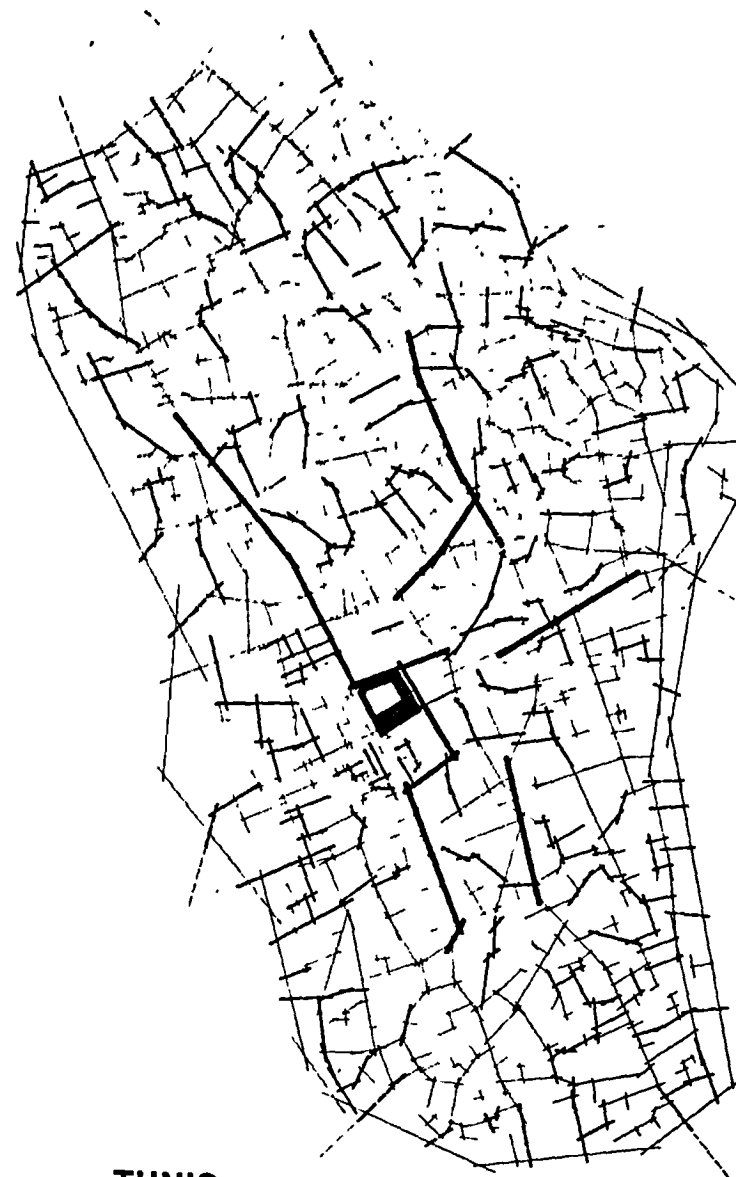
TUNIS

FIG. 3.6: RADIUS-3 INTEGRATION CORE (10%)



TUNIS

FIG. 3.7a: CHOICE AND JOURNEY PATHS
 — 25% of strong choice lines
 - - Strong journey lines (equal number to strong choice lines)



TUNIS

FIG. 3.7b: CHOICE STRUCTURE (T.3)
 — 25% of strong choice lines

THE TOWN OF ALGIERS:

The axial system of Algiers in Figure 3.8, with 505 distributed lines and 752 including the non-distributed, corresponds to the third largest in the sample. The overall axial structure appears, by contrast to Tunis, more broken up. A long axial route seems to be formed by lines meeting at much wider angles and runs from the town's gate "Bab-el-oued", across the trading section, and continues along the periphery towards "Bab-Azoun". The axial lines found on the periphery are predominantly shorter and in much greater number than in the case of Tunis. Similarly to Tunis, the axial structure of Algiers presents a ratio of 1.489 of the total number of axial lines against the distributed lines, with a mean depth of the non-distributed lines of 1.544. The long axial routes are also in this case, formed by lines of average length intersecting at open angles, and form a kind of a "star structure" as they run from the four town's gates and all converge towards the trading quarter located at the periphery (see fig. 3.8). A fifth axial route links the citadel to the commercial axis. The axial organisation of the upper part of Algiers appears to be much more broken up than the lower part where the lines are fewer and longer.

THE "LOWER AND UPPER" PARTS OF ALGIERS:

The quarter boundaries in Algiers are not known, except for the two unequal parts with the smaller and lower part inhabited by the ruling and elite class; and the upper part inhabited by Moors and emigrants

from the southern regions of the country and Berbers, who were reported to form separate communities occupying distinct quarters (Comedor, 1974, p. 7). For this reason, the comparison of the parts of the whole should not be seen on the same basis as for example the previous case.

	A1 Whole town	P.A1 Lower part	P.A2 Upper part
K	505	90	422
MEAN CN	3.097	3.2889	3.0142
MAX. CN	10.00	8.00	10.00
MEAN RRA	1.6121	1.1745	1.6050
MAX RRA	2.3037	1.6800	2.2300
MIN RRA	1.2077	0.7900	1.1800
ST.DEV.(RRA)	0.1938	0.2168	0.2070
1:RA/CN	0.4600	0.5100	0.4500
REL.INTELL.	-.0621	-.1880	-.0931
1:RA/RCH	0.6400	0.8000	0.6000
REL	+.0614	+.0485	+.0011
CN/CH	0.5300	0.5000	0.5800
CV/CH	0.4000	0.4000	0.4300

TABLE 3.4: FIRST AND SECOND ORDER MEASURES
OF THE PARTS OF ALGIERS.

Table 3.4 sets up the results of the analyses of the two parts taken separately and the town as a whole. It indicates that the mean connectivity of the two parts does not present major difference and remains fairly the same when the system is taken as a whole. The

maximum connectivity increases in the large systems, but the level of integration worsens considerably in the larger systems. The maximum segregation (max. RRA) also increases in the upper part (P.A.2) and in the system taken as a whole.

The results show also that the relative intelligibility ($1:RA/CN$) of the two parts is poor, but slightly improves in the large system. The relative value of movement interface ($1:RA/RCH$) of the two parts is average and also improves in the town taken as a whole; but, the local predictability (CN/CH) and the interface potential (CV/CH) do not change substantially in the parts and the whole.

The integration core of the lower part of the city forms a cluster in the central part of the system, strongly connected to the periphery on the harbour side where the great mosque is located, without linking to the neighbouring part (see fig. 3.9).

The integration core of the upper part presents a linear structure running along the street running towards the citadel (see fig. 3.9) close to the north-eastern periphery, and from which branch off lines penetrating the central part of the quarter. The core does not connect to the outside nor to the lower part of the town, but points towards the citadel and the market streets.

SPATIAL PROPERTIES OF THE WHOLE SYSTEM

	A1	A2	A3
K	505	752	443
MEAN CN	3.097	2.891	3.0293
MAX. CN	10.00	11.00	10.00
MEAN RRA	1.6121	1.5672	1.6030
MAX RRA	2.3000	2.1800	2.2566
MIN RRA	1.2100	1.1700	1.2204
ST.DEV.(RRA)	0.1938	0.1870	0.1912
1:RA/CN	0.4600	0.5100	0.5100
REL.INTELL	-.0621	+.0376	-.0275
1:RA/RCH	0.6400	0.6500	0.6600
REL	+.0614	+.1193	+.0665
CN/CH	0.5300	0.5800	0.5500
CV/CH	0.4000	0.4100	0.3600

TABLE 3.5: FIRST AND SECOND ORDER MEASURES OF ALGIERS

The results of the different analyses of Algiers in Table 3.5 show that the mean connectivity remains fairly constant in the different analyses, decreasing only a little in the system taken with the dead-end spaces (A.2). Similarly, the maximum connectivity does not change in the three analyses and is below the urban average (14.28). The level of integration is by far lower than the integration of the previous case; it improves only slightly when the cul-de-sacs are added (A.2), but remains constant when the peripheral streets are discounted (A.3). The maximum segregation (MAX. RRA) in this latter reaches 2.2566 compared to 1.78 in Tunis.

Unlike Tunis, the relative intelligibility of Algiers is low (A.1); it improves in the system looked at with the dead-ends (A.2) and when the peripheral streets are removed (A.3). The improvement of the intelligibility of the system when the cul-de-sacs are added (A.2) may be explained by the fact that the added dead-end lines are both less integrated and poorly connected. As a result, this would create a "tail" in the graph improving then the overall correlation. The relative value of movement interface of the town (A.1) is high and increases substantially in the system with the dead-ends (A.2), but remains constant when the peripheral streets are removed. But, the local predictability of the town according to the three versions does not vary substantially. The interface potential is also low and does not vary strongly, with the exception of A.3.

Figure 3.10 shows the 5% and 10% most integrated spaces in A.1, which form a large ring in the central part with few lines expanding along the market streets and the "Casbah" street, connecting to the periphery but not to the outside. The six most integrated spaces lie on the "Casbah" street, linking the citadel to one of the main market streets. The 7th, 9th, 10th and 11th most integrated lines lie on the borders of the two parts on the market streets, where the palaces and mosques are located. The most segregated spaces concentrate mainly on the peripheral areas of the system. Many of the spaces of the lower part are segregated.

In the system considered with the dead-end spaces and by contrast the previous version, the 1st, 3rd and the 5th best integrators run along the main market street, while the 2nd and the 4th best lines lie

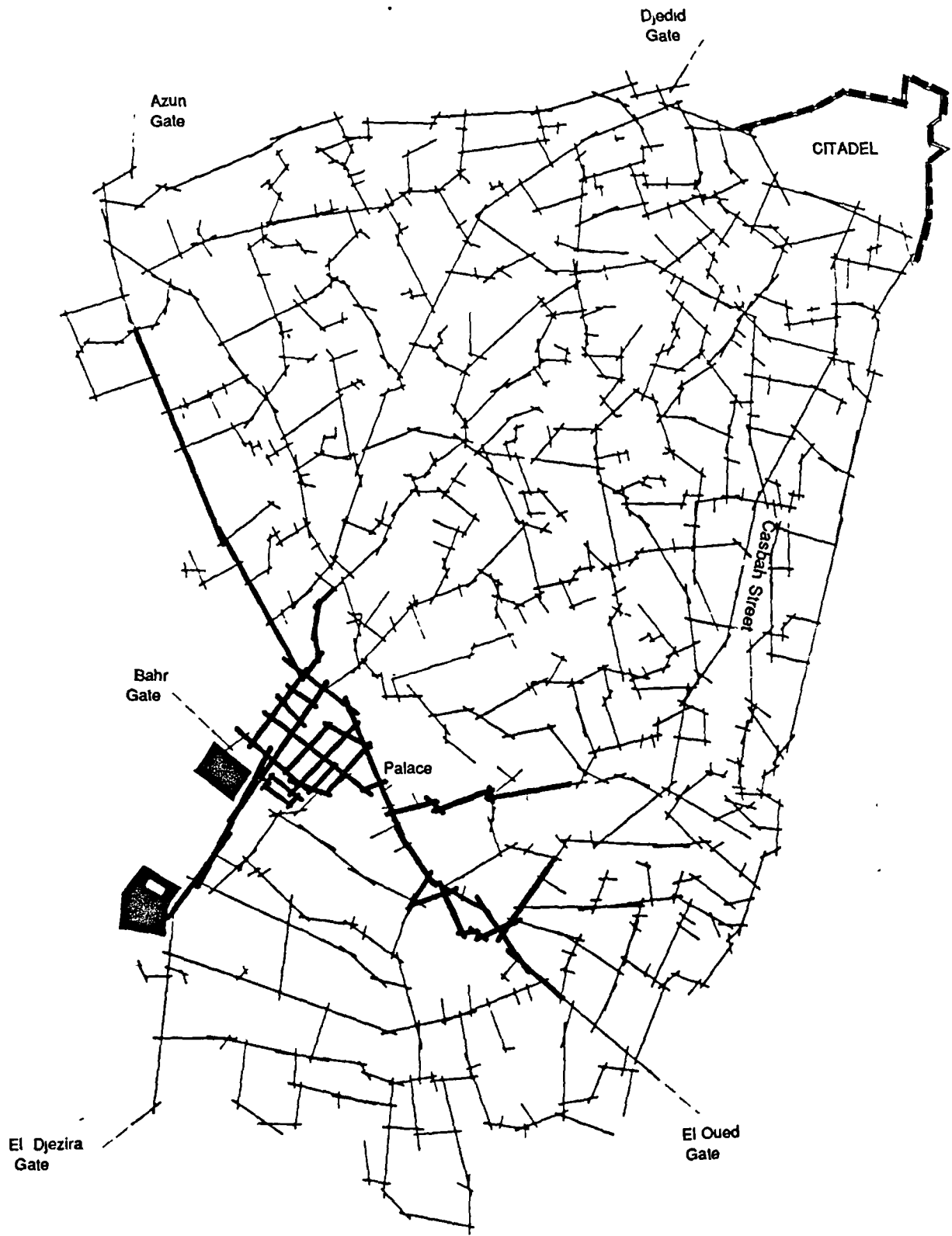
on the "Casbah street" (see fig. 3.11a). The overall shape and location of the core remains similar to A.1; and the segregated spaces include most of the dead-ends (75.7% of the total number of dead-end spaces in the system). The integration core of the system without the peripheral streets (see fig. 3.11b) is very similar to version A.1. The best integrators which are on the "Casbah street" remain the same in both versions (A.1 and A.3).

Radius-3 integration core includes many spaces of radius-n core (see fig. 3.12), but it breaks up into two clusters, one of which develops along the main commercial street and the other along the "Casbah street" and runs close to the citadel in the upper part of the town. The comparison of radius-3 core and the combined core of the two parts (see fig. 3.9) indicates that most of the spaces of the integration core of the upper part form part of radius-3 core. On the other hand, the comparison of radius-n core of A.1 (see fig. 3.10) and the combined core shows that the first four best integrators in A.1 remain the same in the core of the upper part, suggesting therefore that this quarter seems to work as "a town within a town"; that is almost independently from the lower part of the city.

The map in Figure 3.13a shows that the strong choice lines (25% of the choice quantities) form a continuous structure developing along the "Casbah street" and the main market street. The best lines in terms of choice lie also on the "Casbah street". The choice structure of the system without the peripheral streets is strongly similar to the core of the system in A.1 (see fig. 3.13b), with the strong choice lines remaining also on the "Casbah street".

The map shows also the most selected lines in the random journeys from the outside. It indicates a strong overlap between the two quantities only in the vicinity of the towngate "Bab-el-oued" on the lower part of the "Casbah street". This is clearly expressed by the correlation (0.5536) between the two quantities, which suggests a possible interface which takes place in a specific area of the town (see scattergram, Appendix 2).

The above results of the spatial analysis of Algiers chiefly point to a different grid structure from Tunis', in that: i- the global core forms essentially a central ring linking the citadel to the mosque/market area; ii- the cores of the two parts stand separate from each other; iii- radius-3 core although it strongly overlaps with radius-n core (A.1), it does not tend to cover the urban fabric as seen in Tunis. But, the results indicate also that the dead-end spaces of the grid do not seem to affect strongly the level of integration of the town as in Tunis.



ALGIERS

FIG. 3.8: AXIAL MAP
 Market Streets

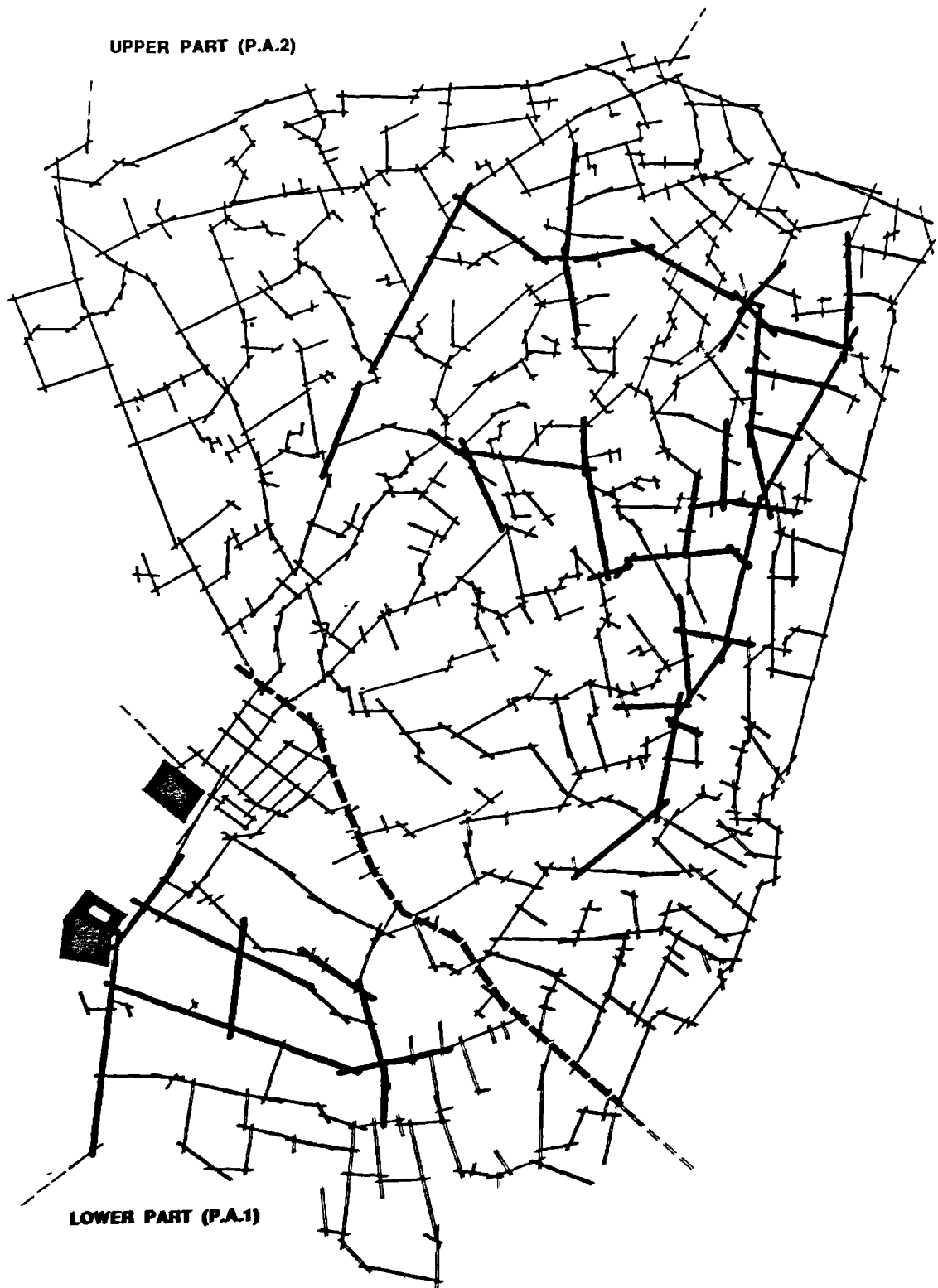
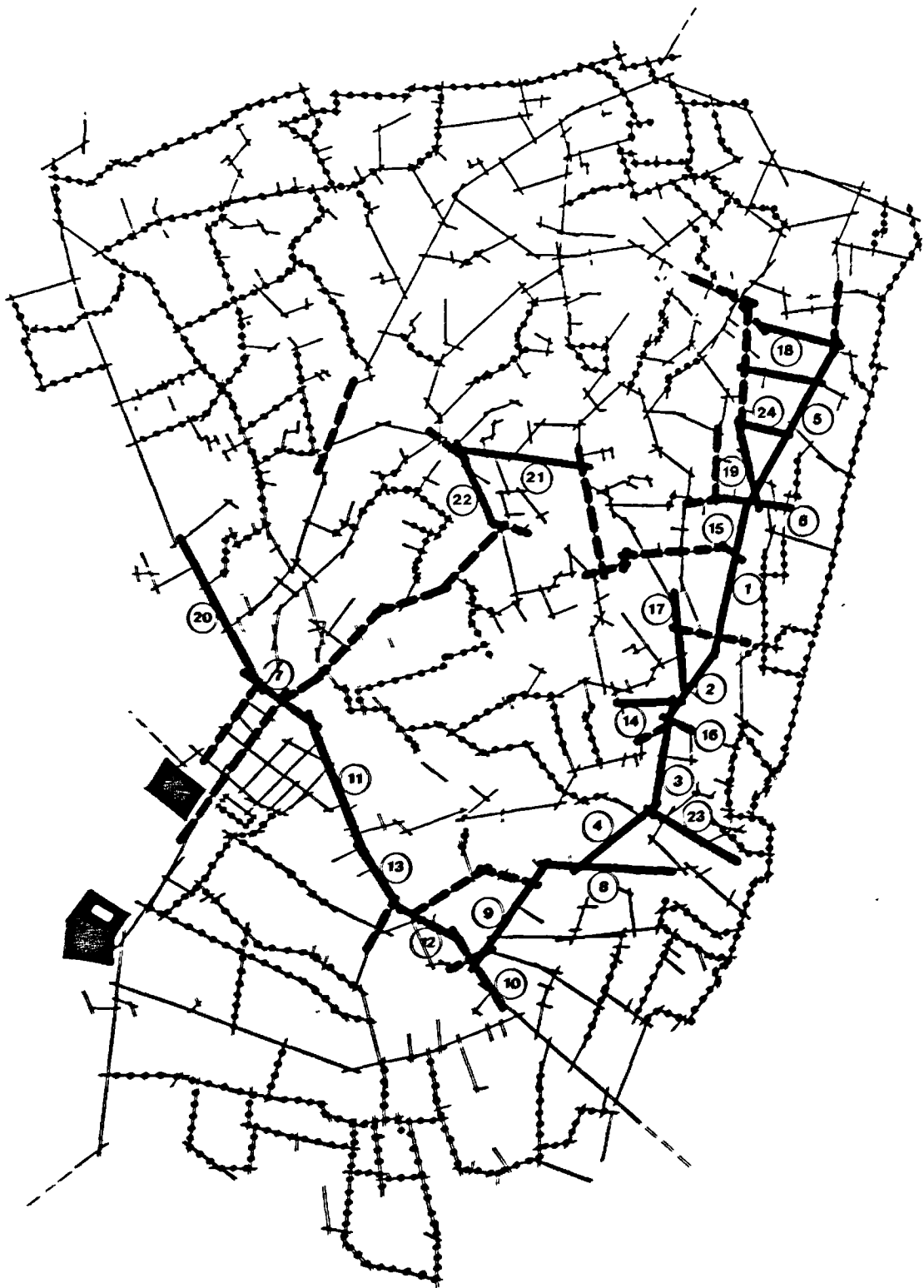
**ALGIERS**

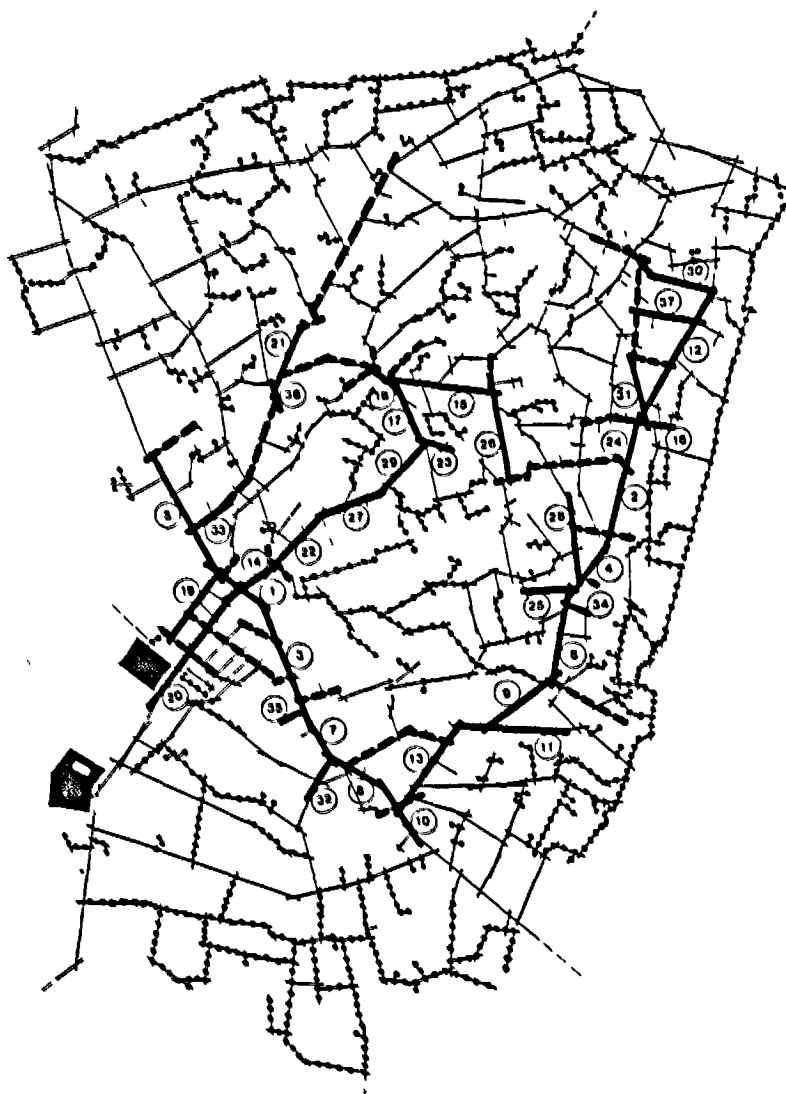
FIG. 3.9: INTEGRATION CORES (PARTS)
— 10% of most integrated lines



ALGIERS

FIG. 3.10: INTEGRATION CORE (A.1)

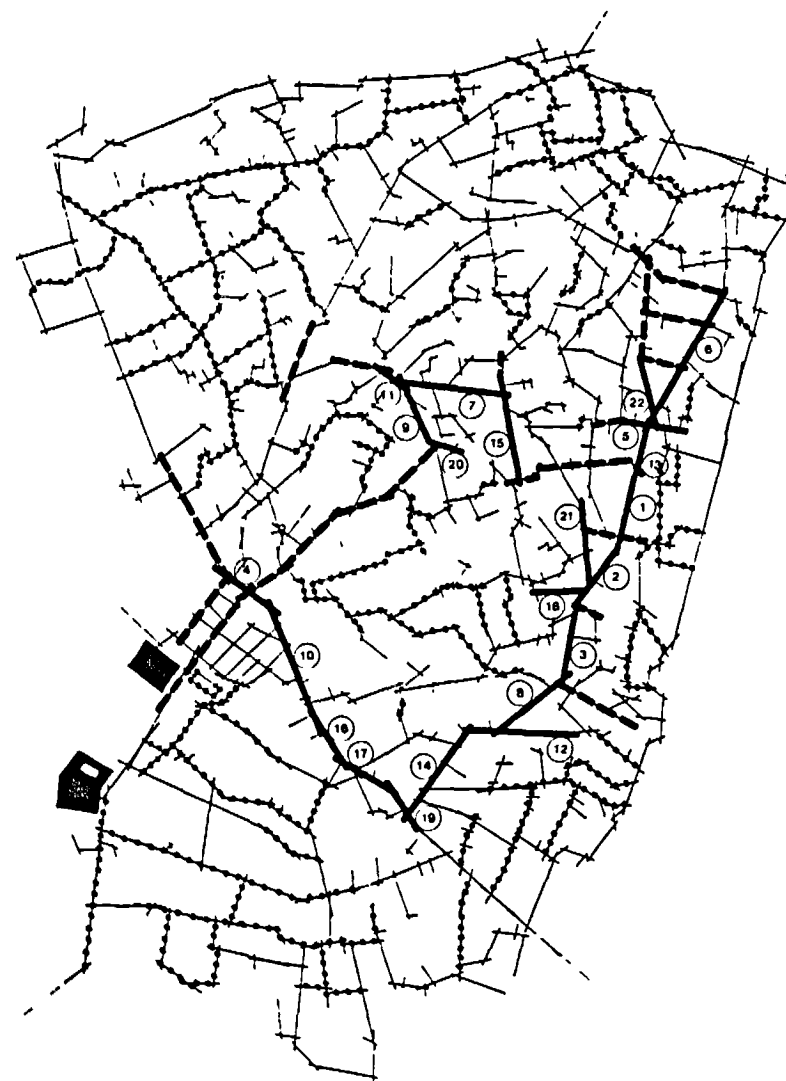
- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines



ALGIERS

FIG. 3.11a: INTEGRATION CORE (A.2)

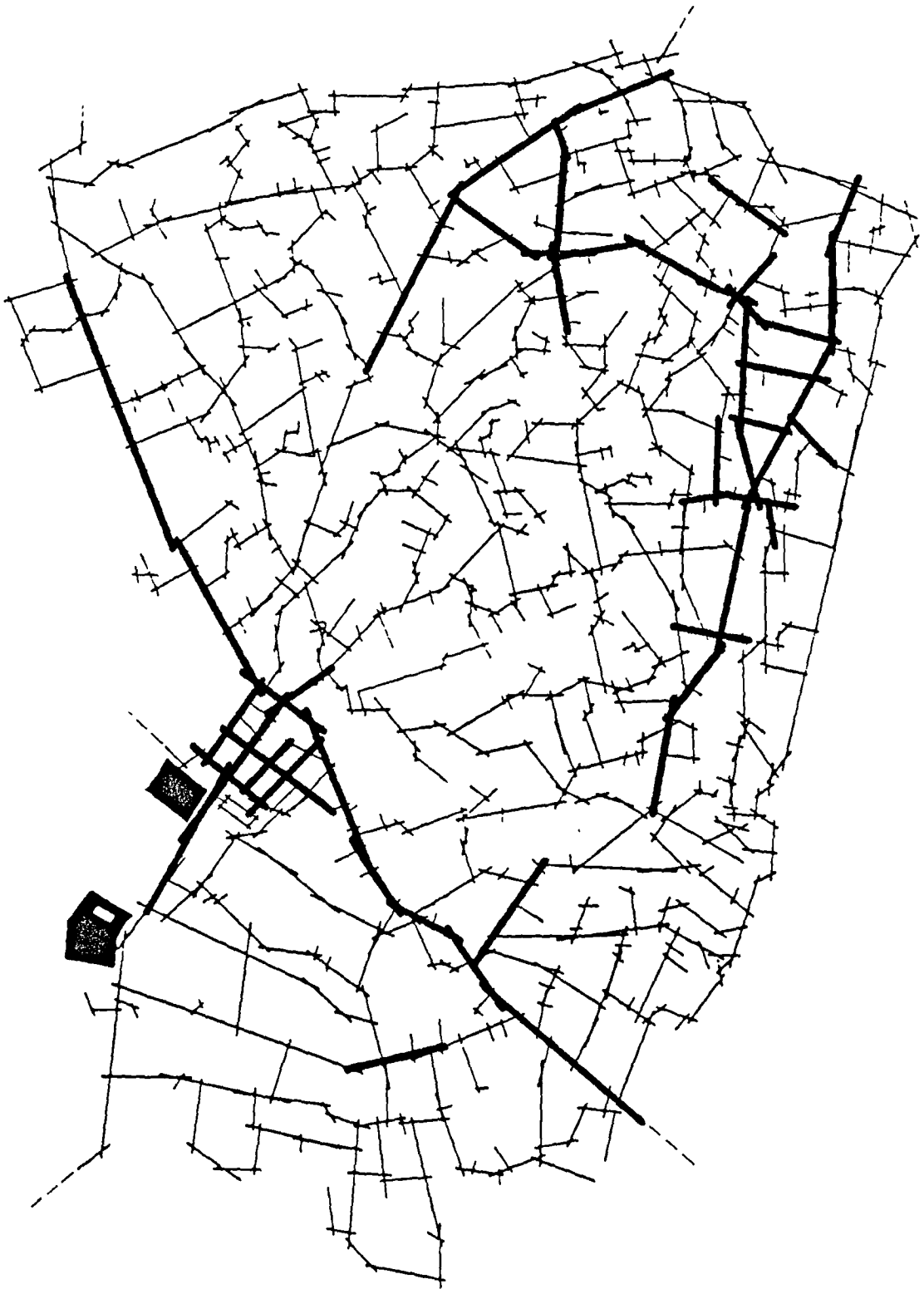
- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines

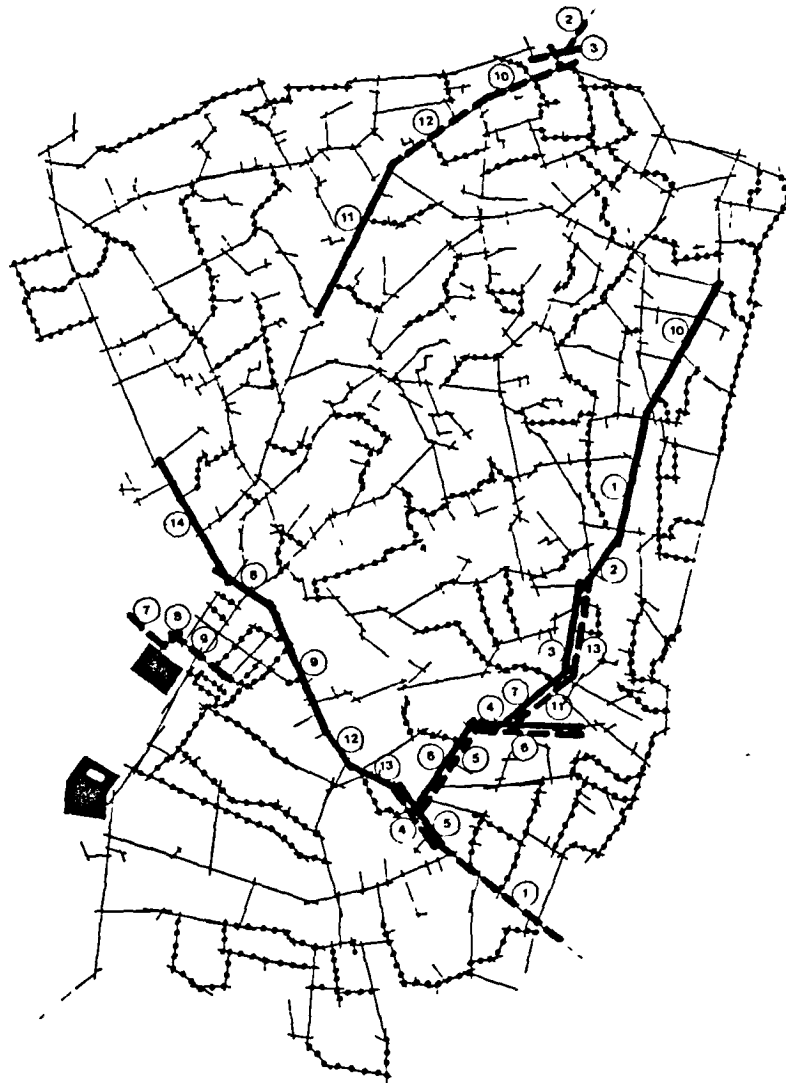


ALGIERS

FIG. 3.11b: INTEGRATION CORE (A.3)

- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines

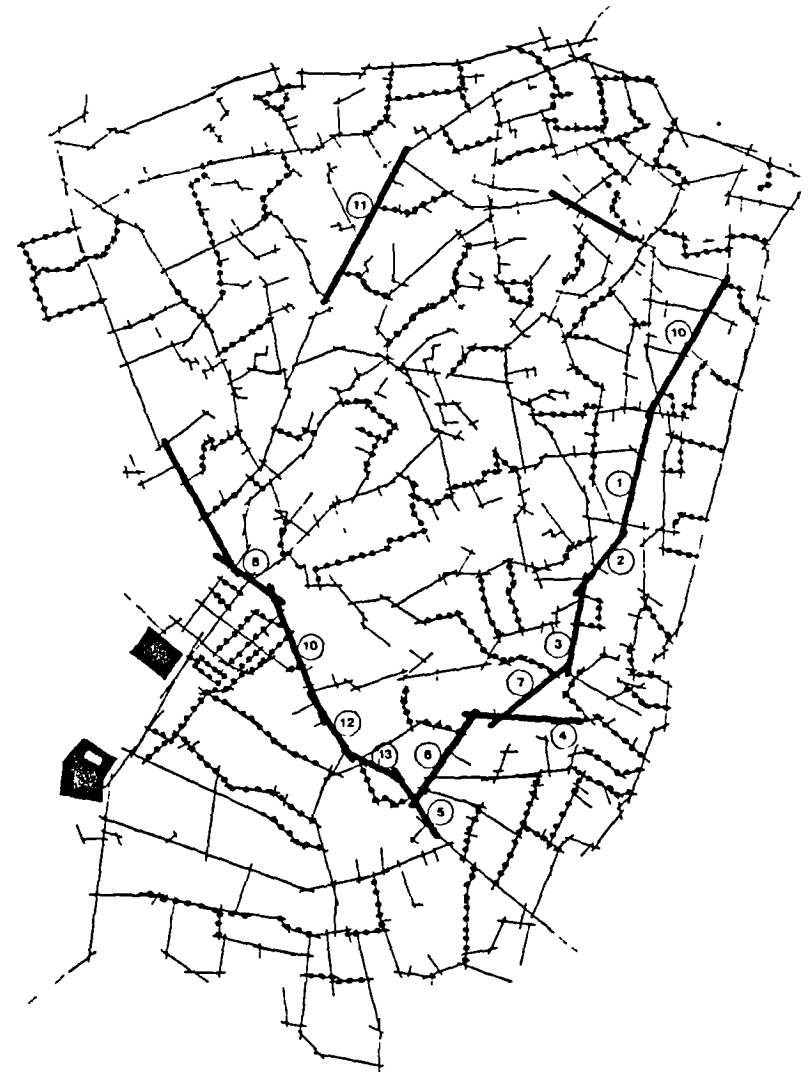
**ALGIERS****FIG. 3.12: RADIUS-3 INTEGRATION CORE (10%)**



ALGIERS

FIG. 3.13a: CHOICE AND JOURNEY PATHS

— 25% of strong choice lines
 - - Strong journey lines (equal number to strong choice lines)



ALGIERS

FIG. 3.13b: CHOICE STRUCTURE (A.3)

— 25% of strong choice lines

THE TOWN OF SALE:

The main feature of the axial structure of this town, by contrast to the two previous cases, is the intersection angles of many axial lines which tend to approach the right angle, and give a sense of regularity to the urban grid of Sale (see fig. 3.14). The longest line in the axial structure forms a clear edge at the eastern side of the system. The dominant axial route runs in the middle of the site from the eastern gate to the opposite western gate, crossing half way the trading area, in 7 axial steps of average length interconnecting at open angles. However, the area immediately west of the market place is constituted more by shorter and broken up lines. The ratio of the total number of axial lines against the distributed lines of 1.631 is slightly higher than the ratio in Tunis or Algiers; but the mean depth (1.4062) of these non-distributed lines is lower than in the two other towns. The largest axial system of the four quarters also corresponding to the oldest (Naciri M., 1963, pp. 18-31) is made up of 205 axial lines; while the smallest counts only 39 axial lines. Each of the four sub-systems is linked at least by one gateline to the outside as is the case of the quarters of Tunis.

SPATIAL ANALYSIS OF THE QUARTERS OF SALE:

	SA1	Q.SA1	Q.SA2	Q.SA3	Q.SA4	MEAN
K	355	62	96	205	39	100.5
MEAN CN	3.3465	3.000	3.1250	3.1800	3.2308	3.134
MAX CN	10	9	7	9	6	7.750
MEAN RRA	1.1852	1.1846	1.1768	1.1110	0.9943	1.1167
MAX RRA	1.7500	2.0260	1.8615	1.6090	1.5700	1.7660
MIN RRA	0.7800	0.7940	0.7013	0.6810	0.5700	0.6860
ST. DEV.	0.1729	0.2950	0.2779	0.1980	0.2618	-
1:RA/CN	0.4900	0.6100	0.7000	0.5700	0.7400	0.6550
REL.INTEL.	-.0725	-.1200	+.0077	-.0503	-.0289	-.048
1:RA/RCH	0.6300	0.6700	0.6000	0.6900	0.7700	0.6825
REL	+.0121	-.1138	-.1457	+.0154	-.0523	-.0740
CN/CH	0.7000	0.7500	0.6400	0.7100	0.7500	0.7125
CV/CH	0.5300	0.6700	0.5100	0.4900	0.5300	0.5500

TABLE 3.6: FIRST AND SECOND ORDER MEASURES OF THE QUARTERS OF SALE

The spatial measures of the quarters and the town as a whole are summarized in Table 3.6 which shows that the local measure of mean connectivity is fairly constant in the quarters and slightly increases when the town is looked at as a whole. The mean of maximum connectivity of the small systems is much lower than the maximum of the whole and varies from one quarter to the other. The table shows also that the mean integration of the 3 largest quarters is almost identical to the mean integration of the whole; the smallest system (QS4) presents the highest integration. While the mean integration of the town as a whole is maintained at almost the same level as the mean of the 4 quarters. The maximum segregation (max.

RRA) on the other hand varies, irrespective of the size of the quarters.

This is also the case of the intelligibility (1:RA/CN) which varies irrespective of the size of the quarters. The mean of the relative intelligibility of the 4 quarters is a little stronger compared to the one given by the system as a whole. Conversely, the mean movement interface (1:RA/RCH) of the 4 quarters is much lower compared to the town as a whole, but the mean of the local predictability (CN/CH) and interface potential (CV/CH) of the 4 quarters remain about the same when the town is taken as a whole, by contrast to Tunis where both correlations worsen in the whole system.

These results point to the conclusion that Sale when taken as whole, improves but not substantially, its maximum connectivity, maintains about the same level of integration, improves its movement interface but becomes a little less intelligible than its parts. The fact that the level of integration of the whole is maintained at almost the same level as the parts with a slight drop in the intelligibility, which is the other way round in Tunis, suggests the existence of a super-structure as in Tunis but of a different type.

The integration cores of the quarters are shown in Figure 3.15 which indicates:

- In Q.SA.1, the most integrated spaces form a structure which traverses the quarter and links to the periphery and to the outside. The core also strongly connects to the two neighbouring quarters.

- In Q.SA.2, the core presents strong resemblance to the core of Q.SA.1, in that it traverses the quarter, links to the outside, to the periphery and to Q.SA.3. The great mosque which is located in this quarter (see fig. 3.14) is strongly segregated.
- In Q.SA.3 and unlike the two previous cases (Q.SA.1 and Q.SA.2), the core is more internal with no connections to the outside nor to the periphery. The core develops along the market streets and connects to Q.SA.1 and Q.SA.2.
- In Q.SA.4, the most integrated spaces form an internal cluster strongly linked to the outside and to the two neighbouring quarters.

Except for the integration core of Q.SA.4, the cores of the three other quarters tend to inter-link to form an overall structure which covers in a diffuse way the fabric, connecting the central part to two opposite town edges. This lends support to the suggestion made earlier that this town presents a super-structure.

SPATIAL PROPERTIES OF THE WHOLE SYSTEM:

	SA1	SA2	SA3
K	355	579	322
MEAN CN	3.3465	2.8774	3.0683
MAX CN	10.00	14.00	9.00
MEAN RRA	1.1852	1.1441	1.3251
MAX. RRA	1.7453	1.7100	2.1300
MIN RRA	0.7785	0.7100	0.7800
ST.DEV.	0.1729	0.1808	0.2707
1:RA/CN	0.4900	0.4700	0.5000
REL.INTELL.	-.0725	-.0356	-.0732
1:RA/RCH	0.6300	0.6100	0.5800
REL	+.0121	+.0474	-.0482
CN/CH	0.7000	0.6700	0.6800
CV/CH	0.5300	0.4300	0.4000

TABLE 3.7: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF SALE

The results of the different analyses of the town of Sale are set up in Table 3.7 which shows a mean connectivity (SA.1) identical to the mean connectivity of Tunis, decreasing markedly when the system is looked at with the dead-end passages. The maximum connectivity is low by reference to the urban average and increases when the dead-ends are added (SA.2). This is a similar result to Tunis where it has been shown that the dead-end structure affects, but not strongly, both the mean and maximum connectivity. The results indicate also that Sale is more integrated than Tunis, but a great deal more

integrated than Algiers (see Table 3.1, p. 167). The level of integration of Sale worsens only when the system is looked at without the peripheral streets (SA.3), but remains almost the same with the system is looked at with the dead-end passages (SA.2) as in Tunis and Algiers. The relative intelligibility ($1:RA/CN$) of Sale is poor in all cases: SA.1, SA.2 and SA.3. It improves only in SA.2. Similarly, the relative movement interface is average and falls when the peripheral lines are discounted (SA.3). The local predictability (CN/CH) and potential encounter of Sale both decrease slightly in SA.2 and SA.3.

From this, it is clear that the level of integration of Sale is not affected by the dead-end structure as in the two previous towns, but unlike Algiers, the peripheral streets have a certain impact on the integration but not on the intelligibility of the system. This is a slightly different result from Tunis where both integration and intelligibility worsen when the axial grid is disconnected from the peripheral lines (T.3).

The 5% most integrated lines in Sale (SA.1) are mainly on the market streets with the 2nd and 6th best lines intersecting at the market place. The 10% most integrated space form a dense cluster in the central part of the town where the commercial streets are located, and is connected but not strongly to the outside and to the periphery (see fig. 3.16). The most segregated spaces develop around the integration core on the periphery of the town. Unlike Tunis or Algiers, all spaces surrounding the great mosque are among the most segregated spaces.

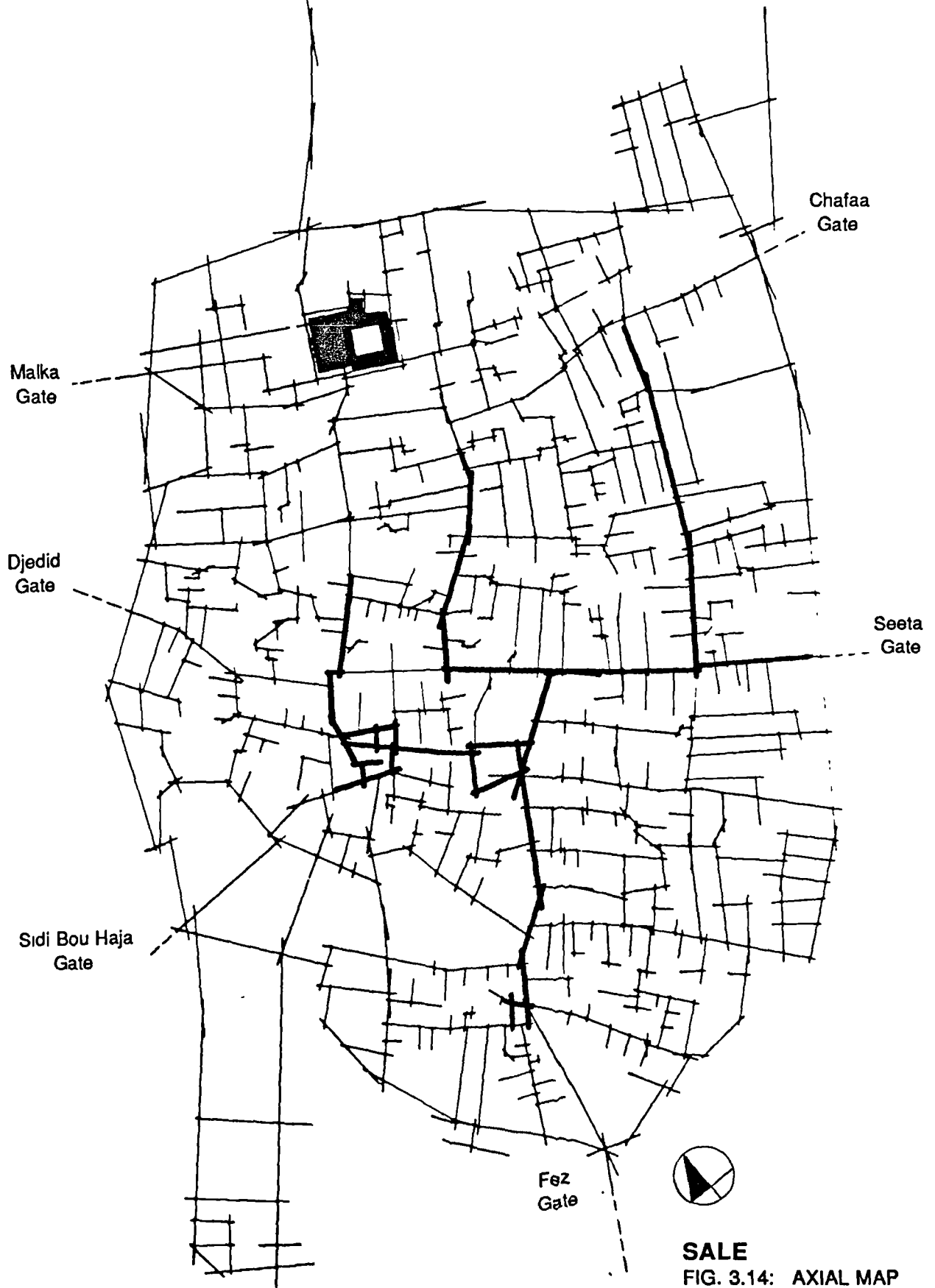
When the system is looked at with the dead-ends (SA.2), the integration core presents similar structure to the previous case: the best integrators remain fairly similar in both versions (see fig. 3.17a). In this case (SA.2), most of the dead-ends (76.78% of the total number of dead-ends) are among the most segregated spaces. The removal of the peripheral streets (SA.3) results in the loss of the connections of the core to the outside, but the overall shape and location of the core remain similar to SA.1 (see fig. 3.17b). The market streets emerge also in this version as the best integrators.

Radius-3 core in Figure 3.18 and similarly to radius-n core (SA.1) runs along the market streets, connects to the outside and to the periphery; but, radius-3 core is more covering, includes more peripheral lines and extends closer to the great mosque which has emerged segregated globally, but appears to be more important at the local level. The overall structure of radius-3 core is diffuse and does not present a dense semi-grid in the market area as in Tunis. On the other hand, the comparison of radius-3 core with the combined core of the separate quarters (see fig. 3.15) shows an overlap of some lines mainly in the market streets; and similarly to Tunis, the cores of the quarters, with the exception of the Jewish quarter at the south-western corner of the system, tend to form a connected global pattern which links centre to edges in three directions. Moreover, radius-3 core appears to link on the one hand, the local cores of the three separate quarters to each other, and on the other, the local cores to the global core. The implications of such local structures will be further examined in Chapter Five where an overall review of the analytic results for all towns will be presented.

The map in Figure 3.19a shows the choice path and the strong lines in terms of randomly generated journeys from the outside. The strong choice lines form an almost continuous structure in the middle of the town, running along the market streets without connecting to the outside. The second and fourth best lines intersect at the market place. The choice structure in the system without the peripheral streets is very much the same as in SA.1 (see fig. 3.19b).

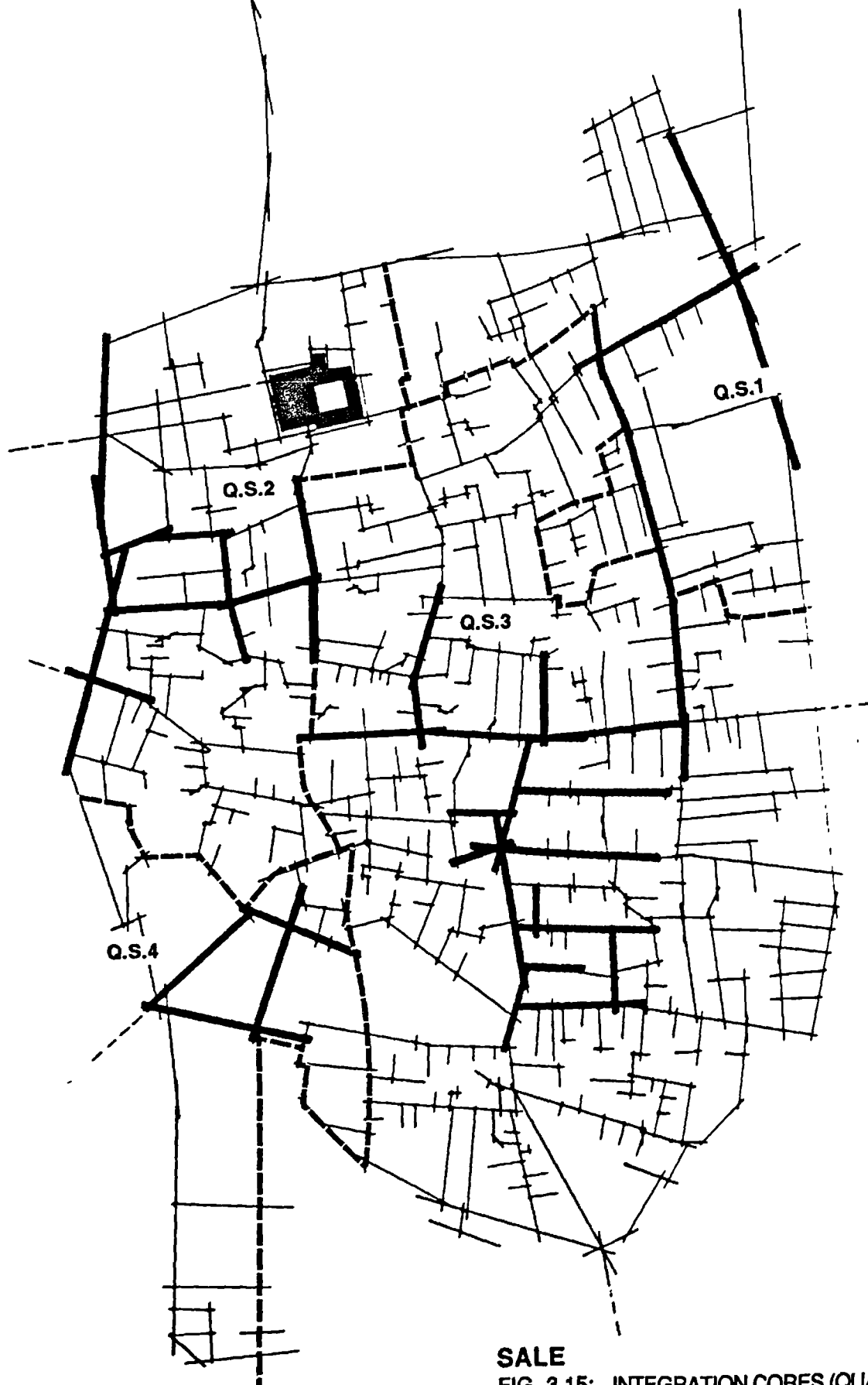
The random journeys' path includes all gatelines and presents one dominant cluster on the eastern side of the town, which overlaps strongly with the choice structure. The correlation between the two quantities (0.5073) expresses a certain type of interface between the two measures, as the graph (see Appendix 2) shows a dominant cluster in the middle, but also a split between the best spaces in terms of choice and random journeys, which tend to form two separate groups on either side of the central cluster. The pattern of the graph differs from those of the previous cases (see Appendix 2), although all three towns (Tunis, Algiers and Sale) have shown about the same correlation coefficient.

The above analysis indicates three main characteristics of the grid structure of Sale which are: i- a clustered global cores in the market area linked on one side to a town gate, mainly compressed compared to the core of Tunis or Algiers; ii- unlike Tunis or Algiers, the main mosque stands segregated with respect to the structure of the grid as a whole; iii- the radius-3 core as in Tunis tends to cover the fabric (with the exception of the smallest quarter) and includes the main mosque; iv- the radius-3 core, as in Tunis, tends to link together the local cores of the quarters.



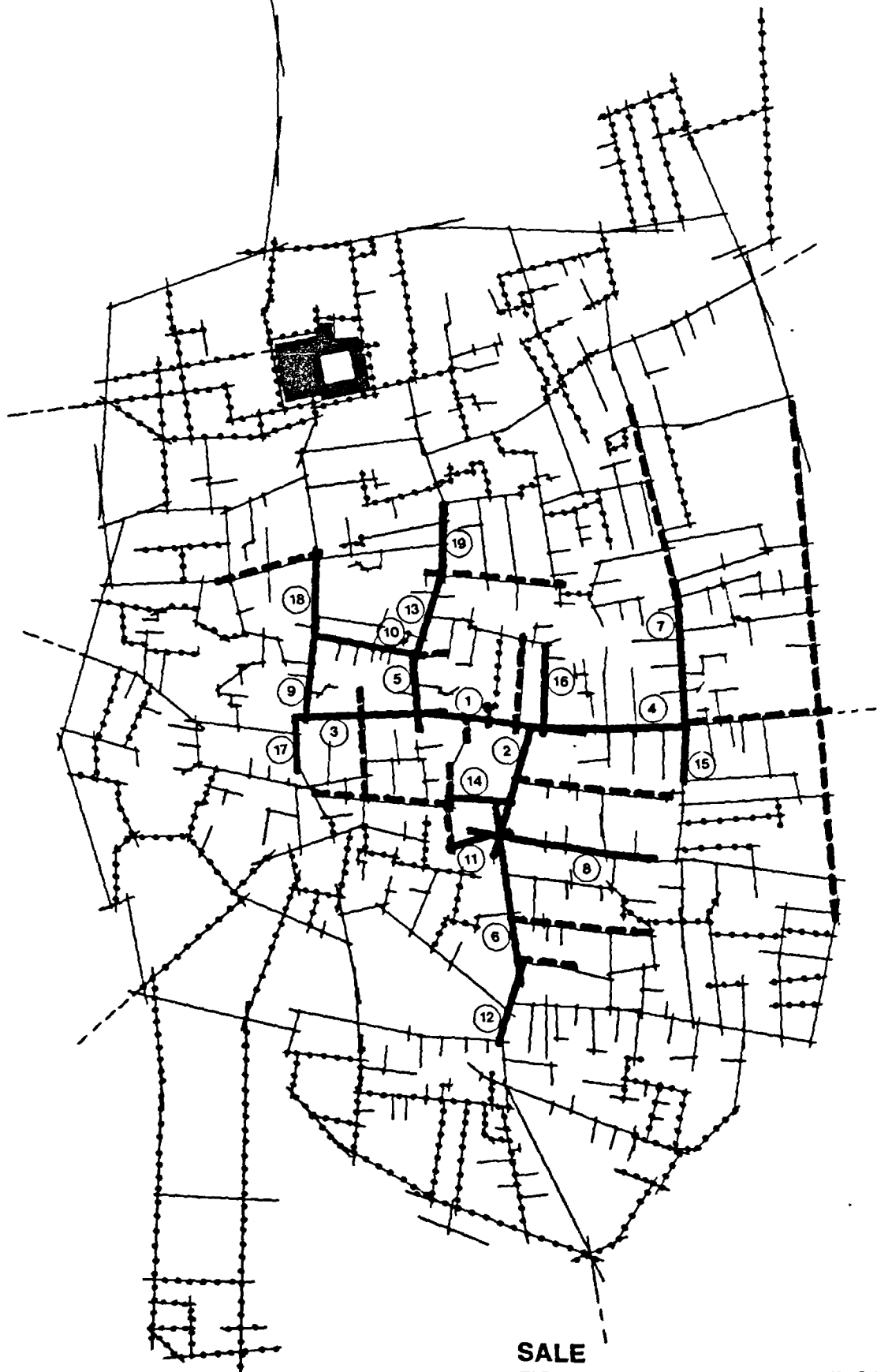
SALE

FIG. 3.14: AXIAL MAP
Market Streets



SALE

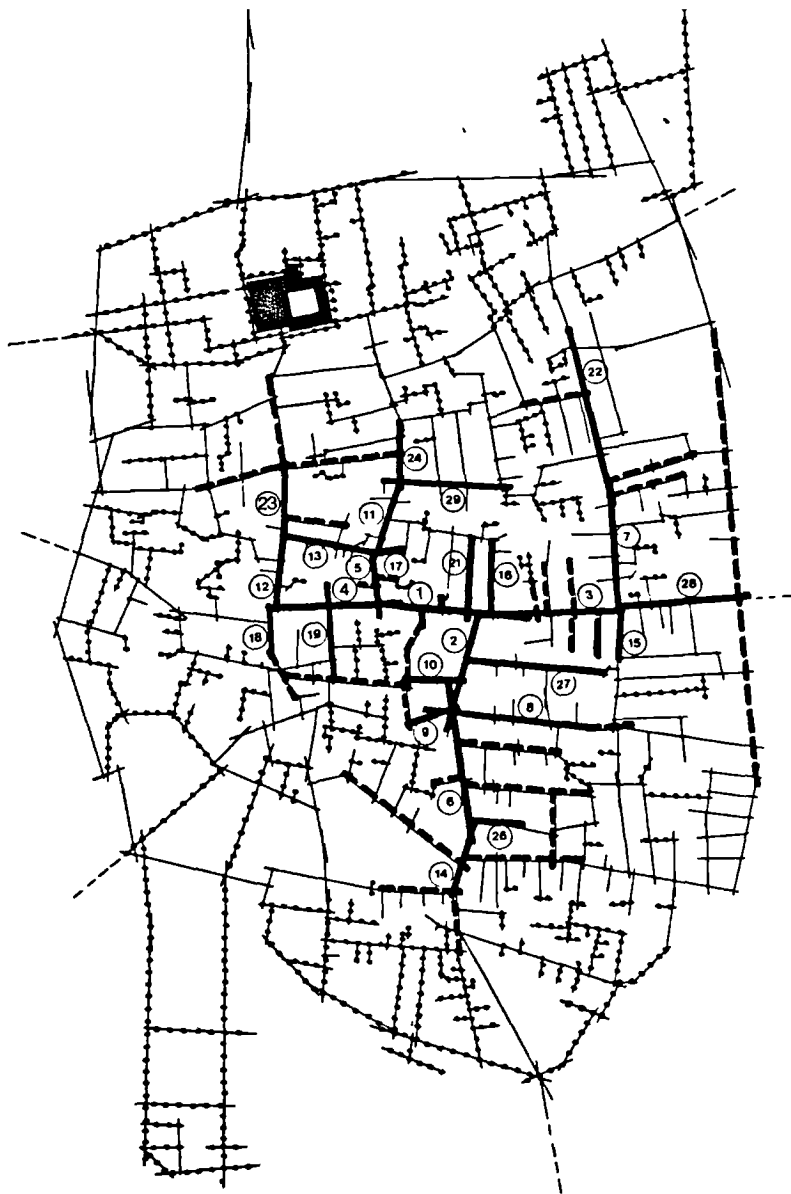
FIG. 3.15: INTEGRATION CORES (QUARTERS)
10% of most integrated lines



SALE

FIG. 3.16: INTEGRATION CORE (SA.1)

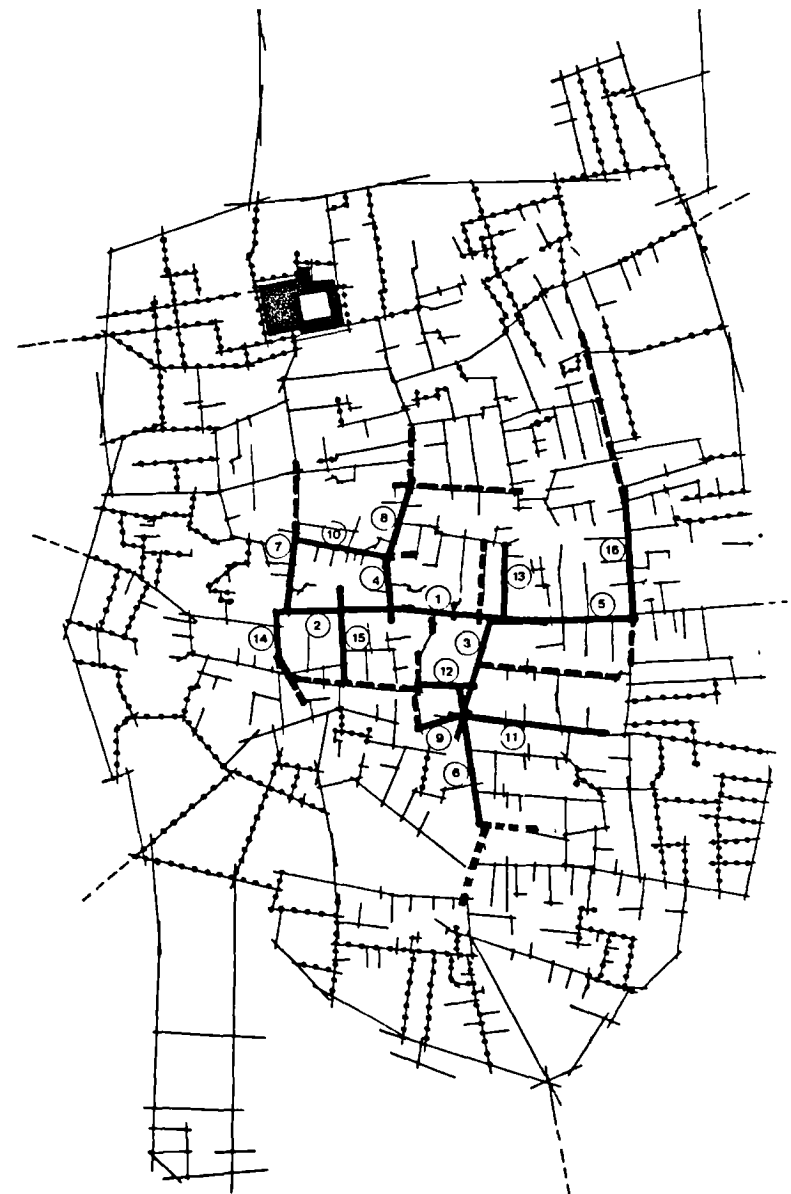
— 5% of most integrated lines
 - - 10% of most integrated lines
 ... 50% of most segregated lines



SALE

FIG. 3.17a: INTEGRATION CORE (SA.2)

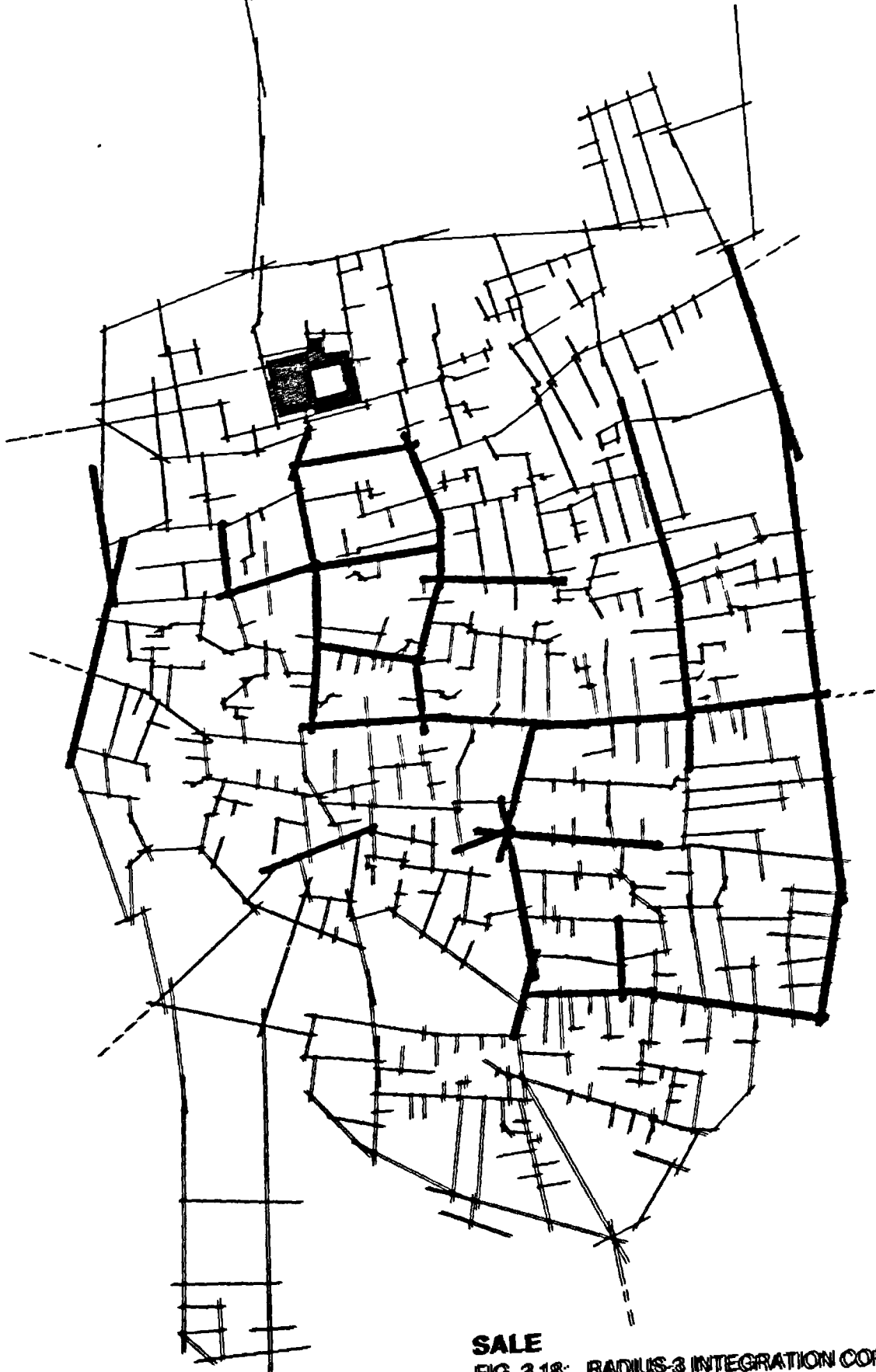
- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines



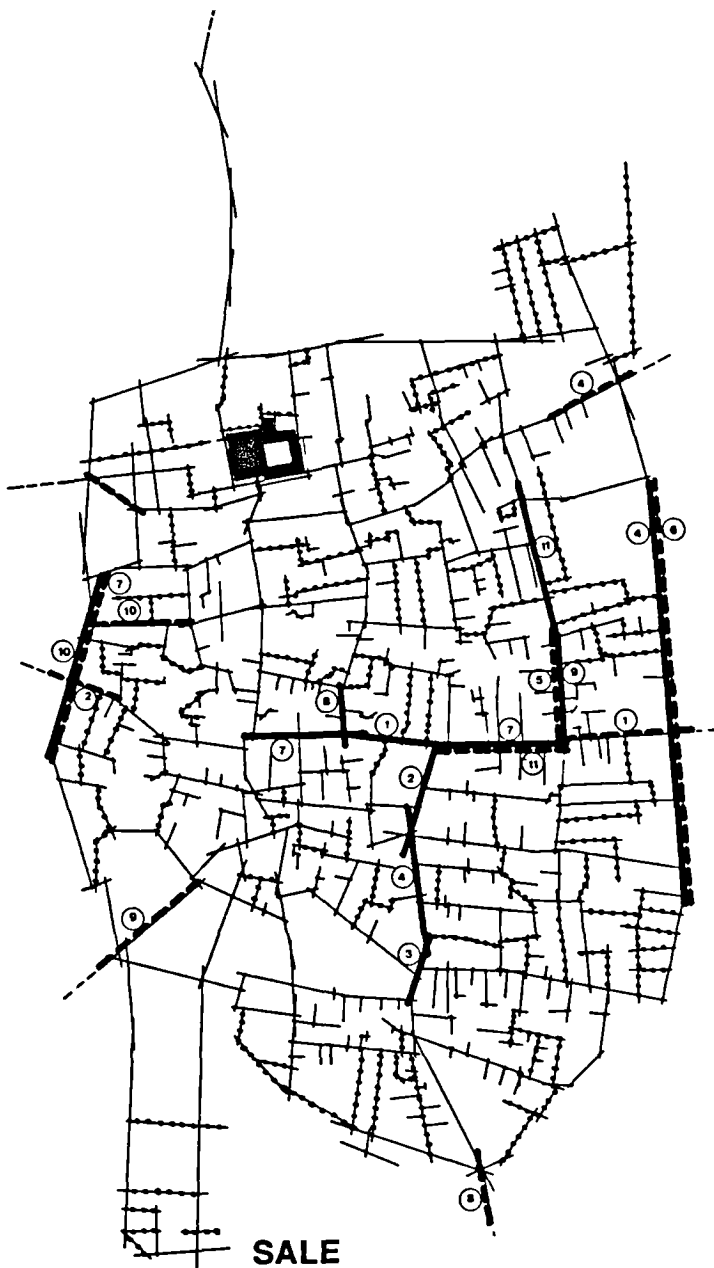
SALE

FIG. 3.17b: INTEGRATION CORE (SA.3)

- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines



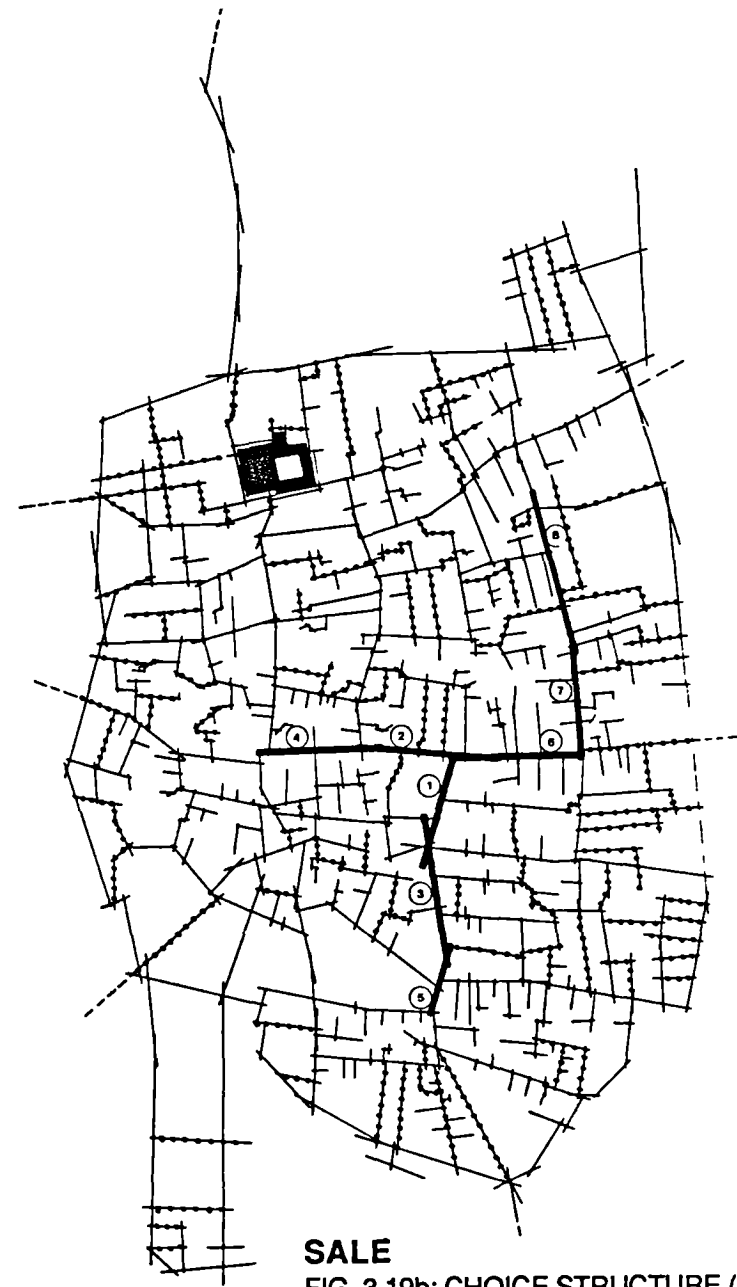
SALE
FIG. 3.18: RADIUS 3 INTEGRATION CORE (10%)



SALE

FIG. 3.19a: CHOICE AND JOURNEY PATHS

— 25% of strong choice lines
 - - Strong journey lines (equal number to strong choice lines)



SALE

FIG. 3.19b: CHOICE STRUCTURE (SA.3)

— 25% of strong choice lines

THE TOWN OF SUSA:

The axial organisation of Susa presents a dominant feature characterized by long axial routes which cross the site east-west and north-south, joining then all the town's gates. These routes which are made up of rather long lines intersecting at open angles as seen in the previous cases, tend to form two kinds of axes dividing the system into parts, and giving an impression of regularity. Inside these "parts" the lines become much shorter and intersect at irregular and oblique angles (see fig. 3.20). Similarly to the previous towns, the non-distributed lines of the system represent about the third of the total number of axial lines (ratio of all axial lines/distributed = 1.478). The axial map shows also a more regular structure with smaller blocks defined by lines meeting at angles approaching the right angle in the vicinity of the market area and the north-eastern corner of the town. Unlike Algiers and Tunis, the non-distributed lines appear shorter. This is shown by a lower mean depth of the non-distributed lines of 1.385 which is hardly lower than Sale (see Table 3.1, p. 167).

The results of the analysis of the town of Susa are summarized in Table 3.8:

	S.1	S.2	S.3
K	255	377	237
MEAN CN	3.1922	2.8117	2.9114
MAX. CN	10.00	10.00	9.00
MEAN RRA	1.2716	1.3070	1.5075
MAX. RRA	1.8370	1.9620	2.8100
MIN. RRA	0.8581	0.8693	0.9200
ST. DEV.	0.2250	0.2255	0.3454
1:RA/CN	0.6200	0.6300	0.5800
REL.INTELL.	+0.0220	+0.0741	-.0256
1:RA/RCH	0.5700	0.5600	0.5100
REL	-.0825	-.0513	-.1500
CN/CH	0.6300	0.6400	0.5600
CV/CH	0.5600	0.3900	0.3700

TABLE 3.8: FIRST AND SECOND ORDER MEASURES OF THE TOWN OF SUSA

As in all previous towns, the mean connectivity of the system decreases slightly when the system is considered with the dead-end structure (S.2) and without the peripheral streets (S.3); it is lower than the mean connectivity of Tunis or Sale. The maximum connectivity is the same as Algiers and Sale, but unlike Sale and Tunis, it does not improve when the dead-ends are added (S.2). The grid structure of Susa presents also a fairly similar level of integration as Tunis, but is much more integrated than Algiers

(1.612). The integration of the system falls slightly when the dead-ends are considered (S.2), but much more strongly when the peripheral streets are removed (S.3). This result points to the conclusion that the town of Susa depends very strongly for its integration on its connections to the periphery. This is clearly illustrated by the substantial increase in the maximum segregation (MAX. RRA) in S.3.

The system presents the highest level of relative intelligibility by comparison to the three previous cases; it improves when the system is considered with the dead-ends (S.2) as in Tunis and Algiers but not Sale. On the other hand, the system of Susa has the lowest (relative) movement interface ($1:RA/RCH$) of all three previous towns which worsens dramatically when the peripheral streets are omitted (S.3).

The integration core of Susa (S.1) in Figure 3.21 shows that the 3 most integrated lines intersect at the main market street. All six most integrated lines run along various market streets, while the 7th, 8th, 9th and 10th best lines constitute two routes leading to the great mosque. The integration core of Susa develops on the eastern periphery forming an edge ring, leaving therefore a large part of the town segregated. The core connects the market streets to the great mosque and the monastery ("ribat), and to the outside on two points. This core structure seems distinctive to this system as it does not resemble any of the cores of the towns already analysed. The most segregated spaces mainly develop on the side opposite the core and form two large clusters, one of which includes the citadel located at the south-western corner of the town.

When the system is looked at with the dead-end structure, the core still forms an edge ring linking the market streets to the great mosque and the monastery ("ribat"), and to the outside (see fig. 3.22a). In this case, the market streets remain also the strong integrators and are better connected to the mosque. The most segregated spaces, many of them dead-ends (80% of the total number of dead-ends), also form in this case two large clusters on the opposite side of the integration core.

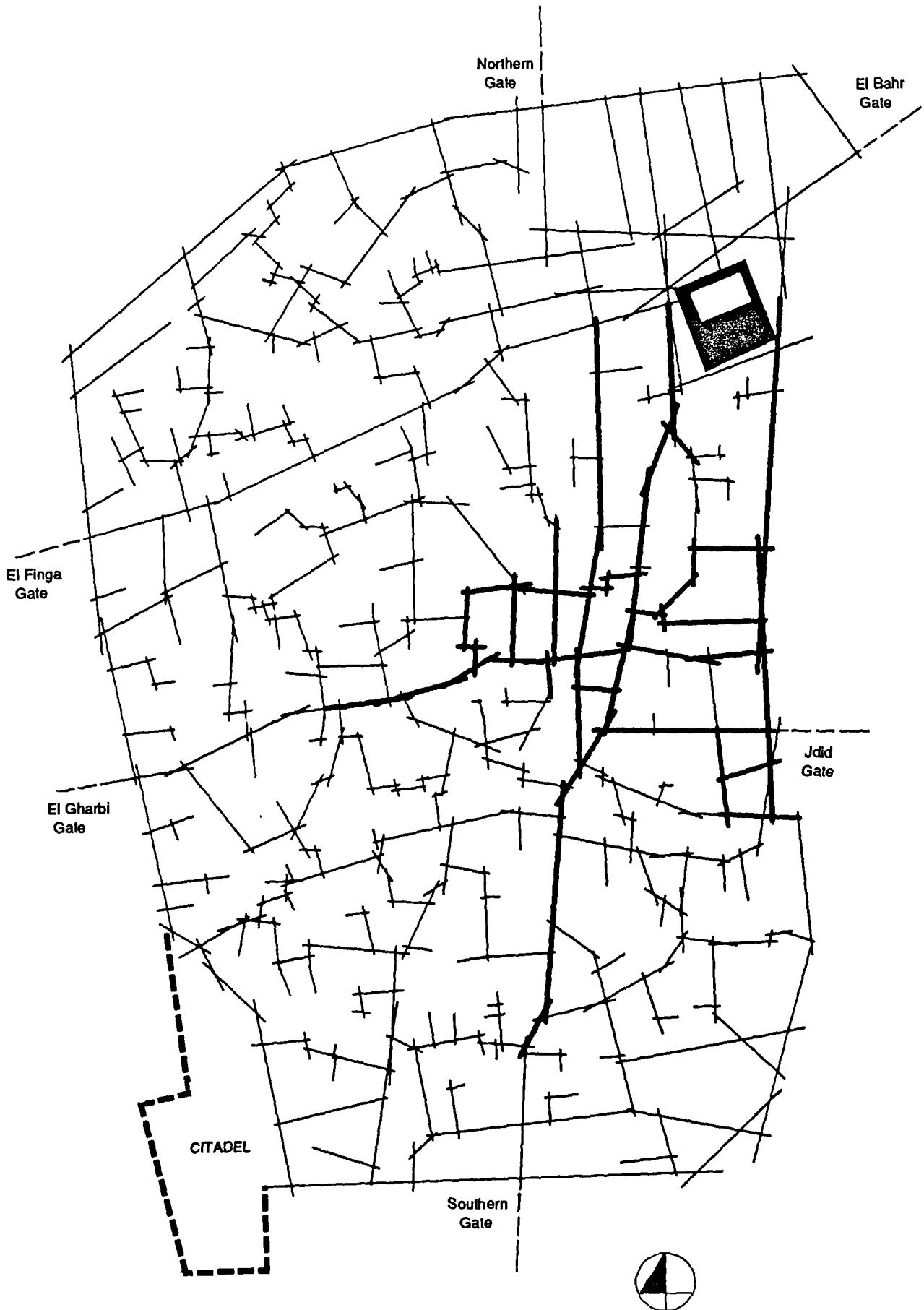
In the system considered without the peripheral streets (S.3), the core in Figure 3.22b becomes concentrated more towards the market area which still connects to the mosque and to the outside, but not to the same degree as in the other cases (S.1 and S.2). The removal of the peripheral streets (some of which forming part of the core in the previous cases, S.1 and S.2) although resulting in a great loss in the level of integration of the town, does not have a strong effect on the location and the overall shape of the core.

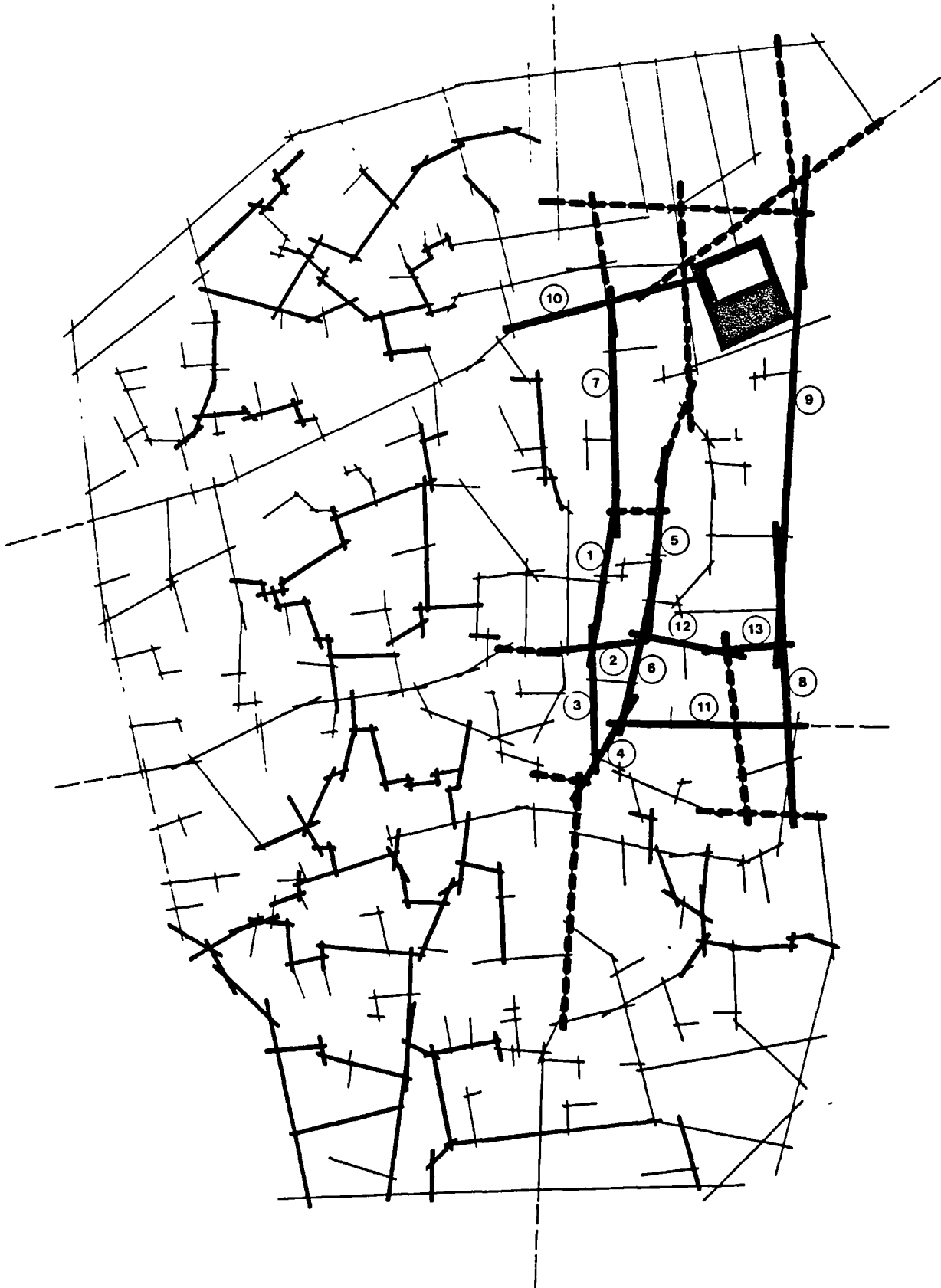
Radius-3 integration core shown in Figure 3.23 corresponds closely to radius-n core as described in S.1 (see fig. 3.21) but excludes the short streets that come off the main core spaces. The regularity observed in the ground plan of Susa as described in Chapter Two, especially the dominance of certain axial routes is not captured by the structure of radius-3 core, as seen in Tunis where radius-3 core tends to cover more this type of routes.

Figure 3.24a shows the resulting paths of the spatial measures of choice and random journeys from the outside. The strong choice spaces form one dominant continuous cluster, developing along the

periphery, from the great mosque, across the market streets and towards one of the gates. The first and third strong choice lines are located away from the market area and the great mosque, on the routes to the town gates. The choice structure tends to cover more the urban fabric than the integration core. The journeys' path on the other hand, does not overlap strongly with the choice structure, and the graph shows a split between the best lines in terms of choice and journeys (see scattergram, Appendix 2). The choice path in the system without the peripheral streets forms an entirely continuous structure strongly connecting the market area to the mosque and the monastery ("ribat"), without however linking to the outside (see fig. 3.24b).

Therefore, the non-covering edge ring core type is a dominant feature of the grid structure of Susa. The "two-sidedness" effect in the overall organisation of the grid, that is one integrated side as opposed to one segregated "zone", is shown as clearly not resulting from the connections of the system to the periphery; but the level of integration does depend strongly on the existence of the peripheral streets. Unlike Tunis and Sale, radius-3 core of Susa does not expand inside the fabric along the axially dominant routes and presents similar characteristics to radius-n core (S.1).

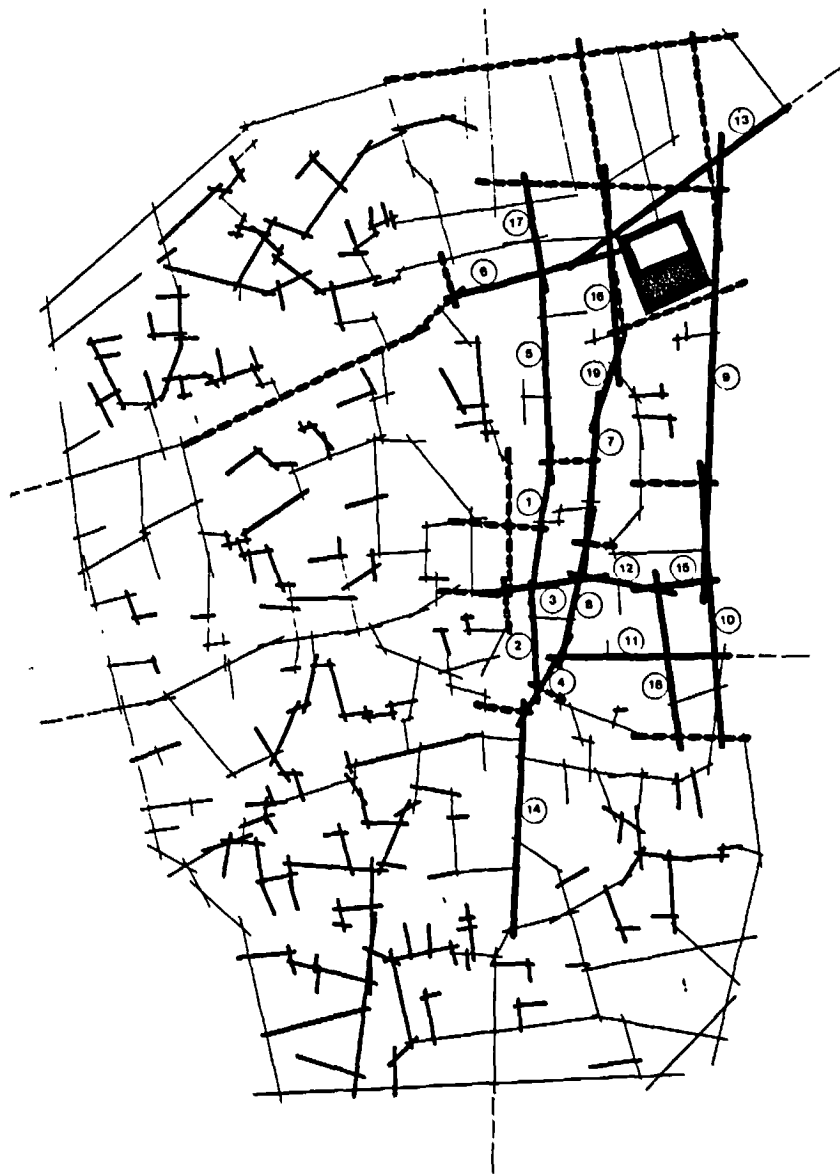
**SUSA****FIG. 3.20: AXIAL MAP****Market Streets**



SUSA

FIG. 3.21: INTEGRATION CORE (S.1)

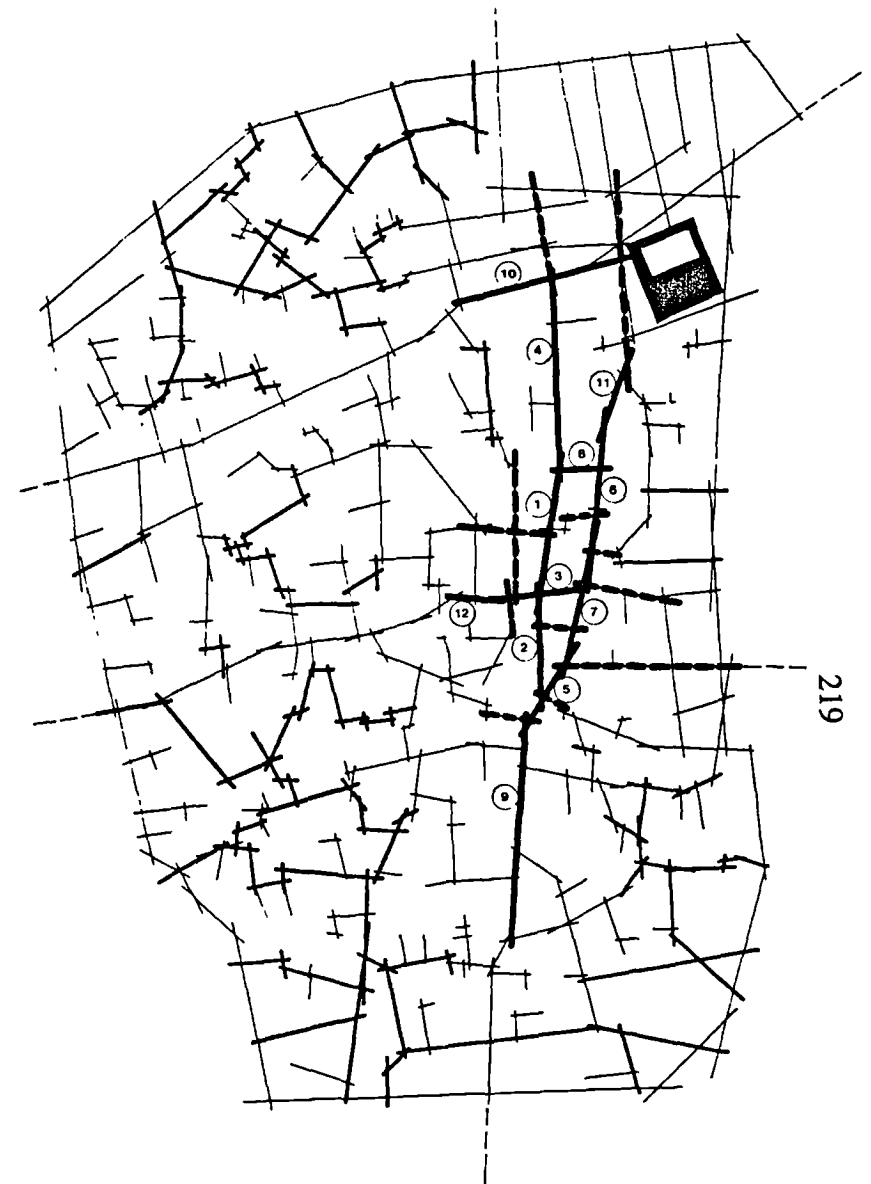
- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines



SUSA

FIG. 3.22a: INTEGRATION CORE (S.2)

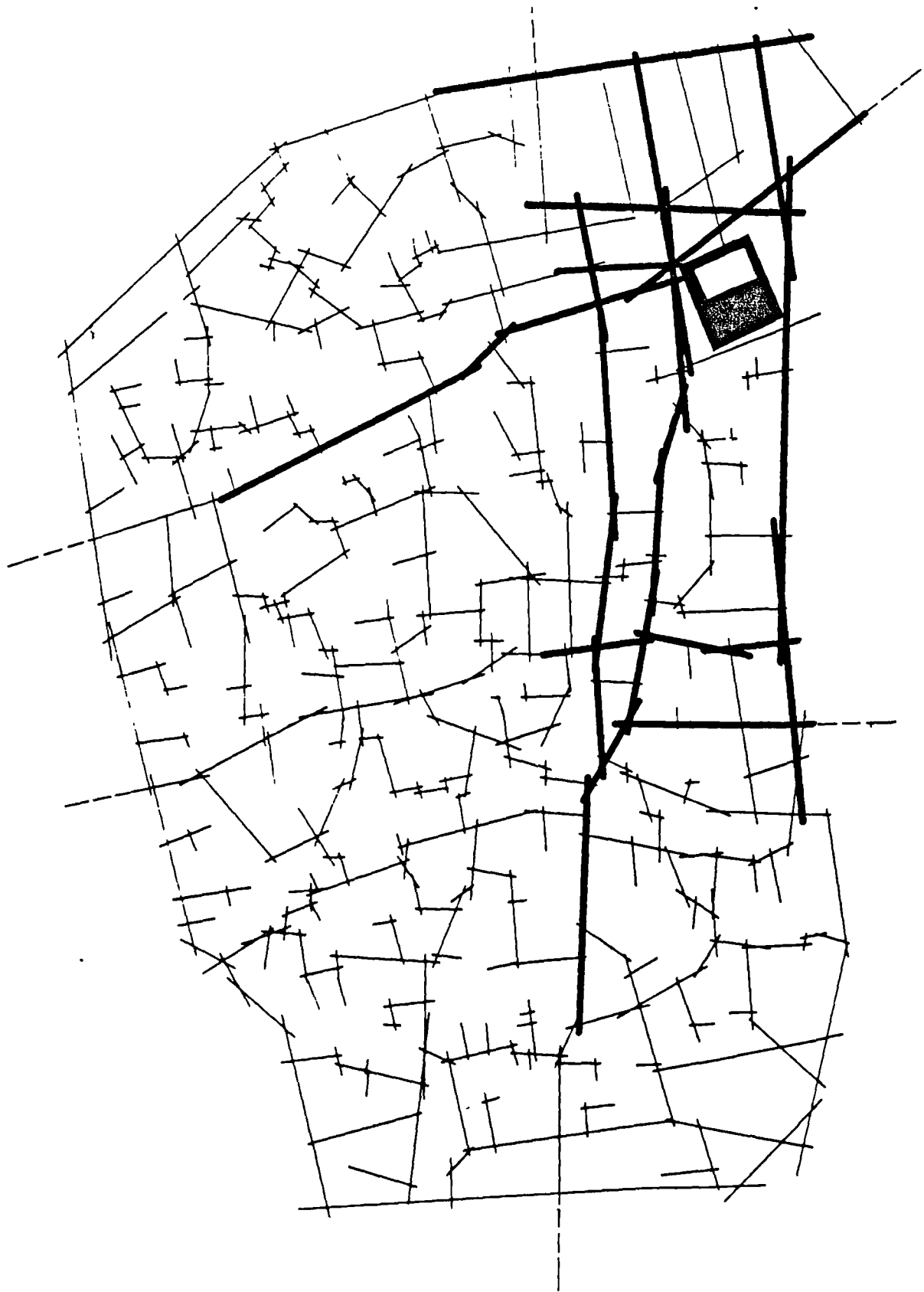
— 5% of most integrated lines
 - - 10% of most integrated lines
 — 50% of most segregated lines



SUSA

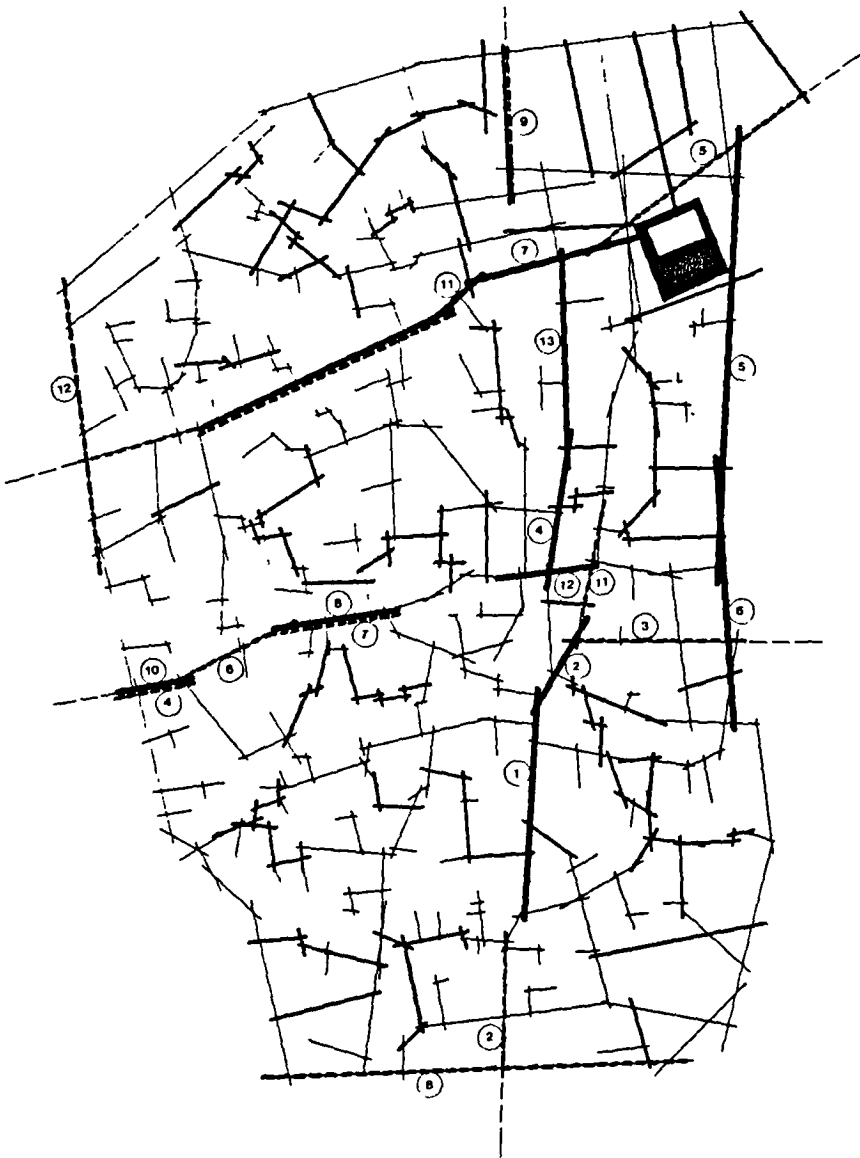
FIG. 3.22b: INTEGRATION CORE (S.3)

— 5% of most integrated lines
 - - 10% of most integrated lines
 — 50% of most segregated lines



SUSA

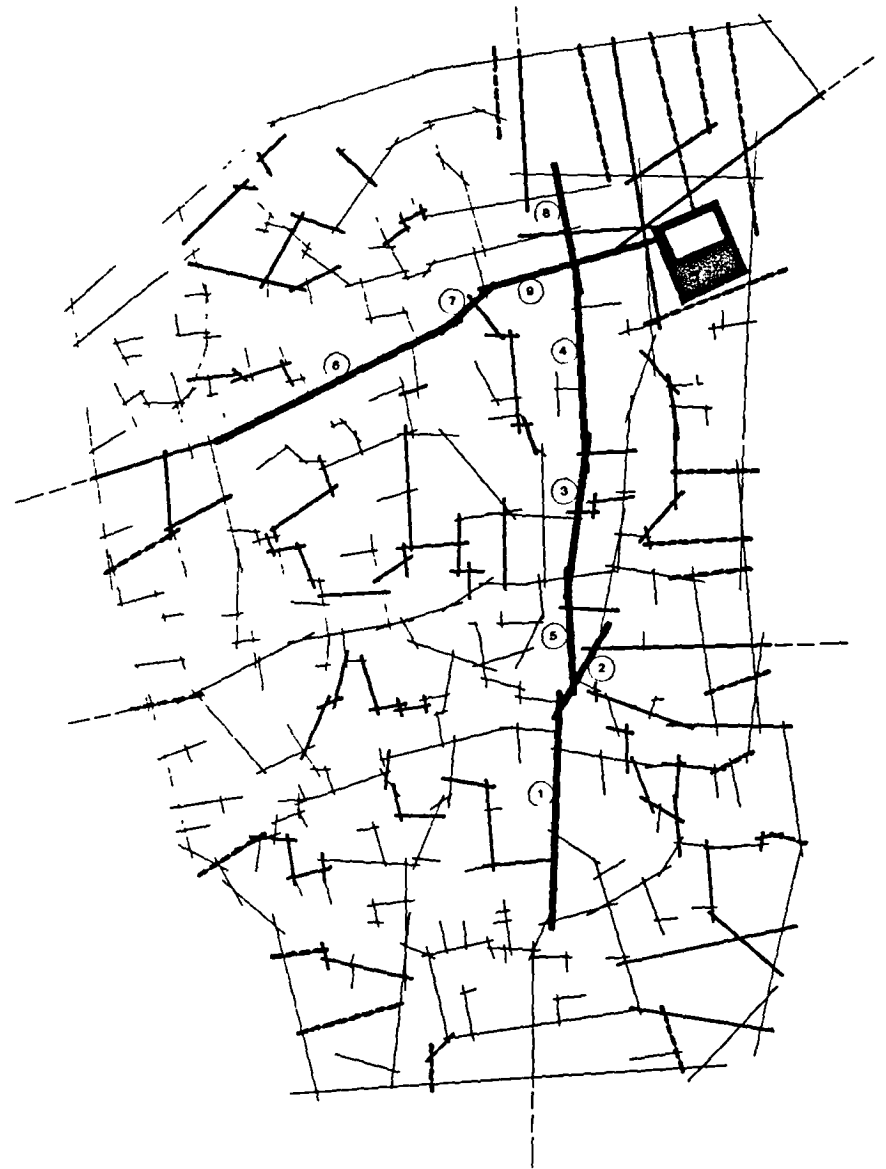
FIG. 3.23: RADIUS-3 INTEGRATION CORE (10%)



SUSA

FIG. 3.24a: CHOICE AND JOURNEY PATHS

- 25% of strong choice lines
- -** Strong journey lines (equal number to strong choice lines)



SUSA

FIG. 3.24b: CHOICE STRUCTURE (S.3)

- 25% of strong choice lines

THE TOWN OF TANGIER:

With the exception of the few longer lines which run transversely across the system in proximity of the great mosque and linking two opposite gateways, the axial structure of Tangier is predominantly broken up and appears to resemble the overall axial organisation of Algiers, especially in the way in which these lines meet at narrow angles and the seemingly highly deformed axial grid (see fig. 3.25). The other prevailing feature of the axial map is the highly distorted town's edges which are defined by shorter and twisting lines and to which connect several long dead-ends. The axial structure seems also to display a larger number of dead-ends than for example Susa. This is shown by a relatively higher ratio (1.611) of the number of the total number of axial lines against the distributed lines as in Sale (1.631). But, the dead-ends in this system appears deeper than the dead-ends in Susa or Sale, and this is also shown by their high average depth which approaches 2 (1.7614).

	T.A.1	T.A.2	T.A.3
K	314	506	-
MEAN CN	2.7516	2.6522	-
MAX CN	10.00	11.00	-
MEAN RRA	1.7726	1.6852	-
MAX RRA	2.7506	2.8400	-
MIN RRA	1.2178	1.1100	-
ST.DEV.	0.3651	0.3375	-
1:RA/CN	0.3700	0.4100	-
REL.INTELL.	-.2050	-.1119	-
1:RA/RCH	0.5600	0.5500	-
REL	-.0709	-.0283	-
CN/CH	0.6900	0.6600	-
CV/CH	0.5200	0.3500	-

TABLE 3.9: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF TANGIER

By far the most obvious characteristic of the present town (*) is that it is much more segregated than all the others, with the exception of Algiers where the level of integration approaches that of Tangier (see Table 3.1, p. 167). This town showed also the lowest mean connectivity of all previous cases; but an identical maximum connectivity. Table 3.9 shows also that the level of integration

(*) It should be noted that the analysis of Tangier, contrarely to the previous cases, does not include a version without the peripheral streets as the buildings in this town are built right against the town walls.

improves slightly, but more than the previous cases, when the cul-de-sacs are taken into consideration (T.A.2).

The system presents also the lowest level of relative intelligibility compared to all earlier cases. It improves, although remaining very poor, when the dead-end spaces are added to the distributed system (T.A.2). The system of Tangier shows also a low relative movement interface which improves in the other case (T.A.2).

The above results clearly indicate a highly deformed and most asymmetric urban grid with the lowest relative intelligibility. Tangier presents another difference when compared to Susa which has the highest relative intelligibility but also the lowest movement interface.

Figure 3.26 shows the integration core of Tangier (TA.1) in which the first and the third most integrated lines intersect at the market place (termed "Petit Socco") and link this latter to the great mosque and to the outside; the second and the fourth most integrated lines also develop along the market streets away from the first and third; while the sixth line leads to the gate of the citadel, indicating a split within the core with respect to the order of integration, by contrast to for example Susa or Algiers. The integration core of Tangier describes in general a large ring in the central part of the town where the "suqs" are located, and strongly connected to the outside and to the periphery. The most segregated spaces form three separate peripheral clusters on either side of the integration core.

In the system analysed with the cul-de-sacs (TA.2), the market place

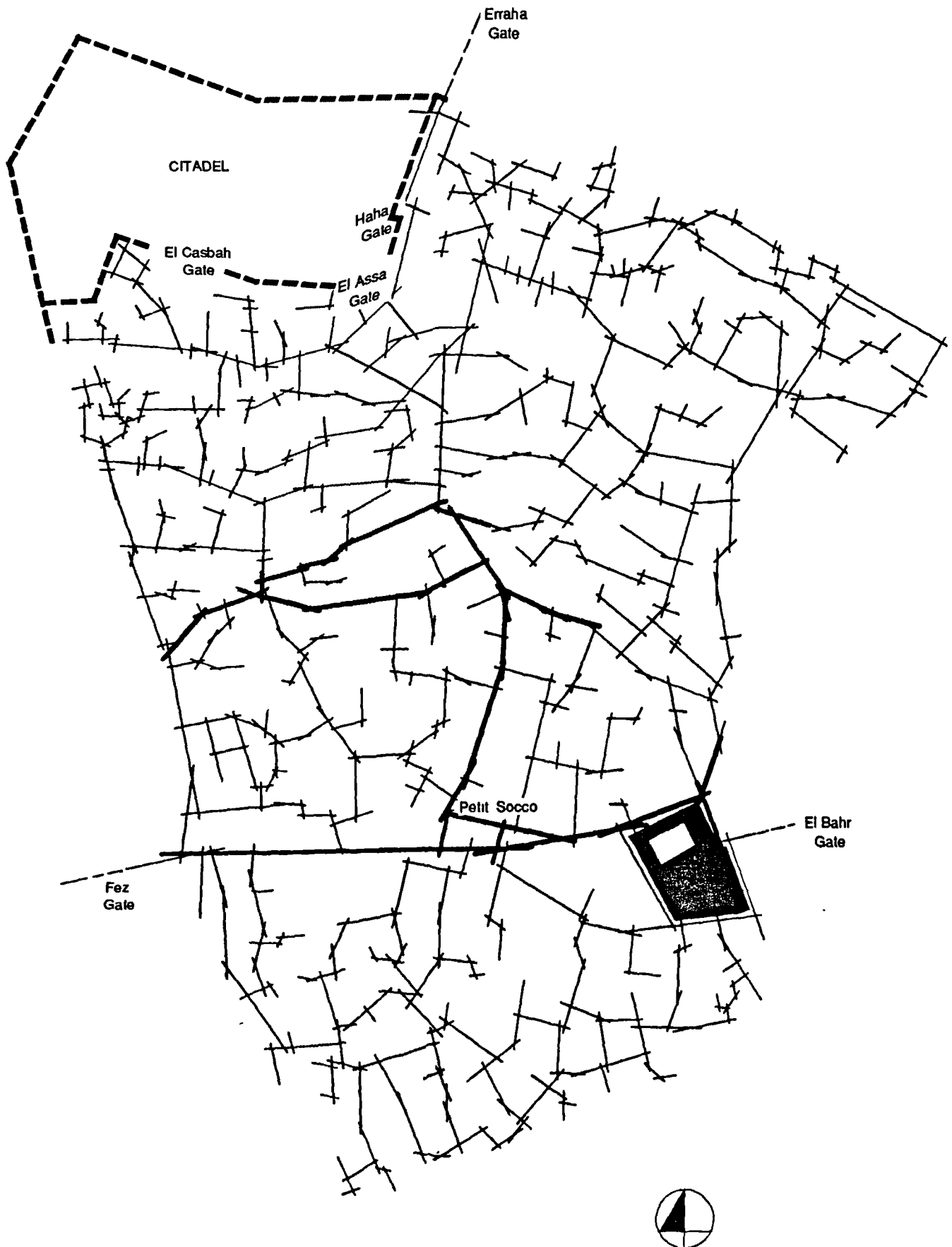
and the mosque are no longer the first and third best integrators as in T.A.1; the system becomes much more strongly oriented towards the citadel than to the outside (see fig. 3.27). The best integrators in this case constitute part of the route which runs from the market place towards the citadel. The difference between the structure of the integration core of TA.1 and TA.2 is very striking, as there is a decisive shift of the core from the mosque and the adjoining market streets towards the citadel. Most of the dead-ends (77% of the total number of dead-end spaces) are among the most segregated spaces. Radius-3 integration core in Figure 3.28 indicates the existence of two "poles", one in the vicinity of the citadel and the other oriented towards the market place and the main streets, and the great mosque. In this town and unlike Susa, radius-3 core almost suggests a "quarter" structure.

The above results clearly indicate a deep ring core type which shows strong similarity to the core of Algiers, where it is also confined to the market streets and points strongly to the citadel. Both towns showed a marked change in the order of integration when the dead-ends are added, although in Algiers it is the market area which gains in integration.

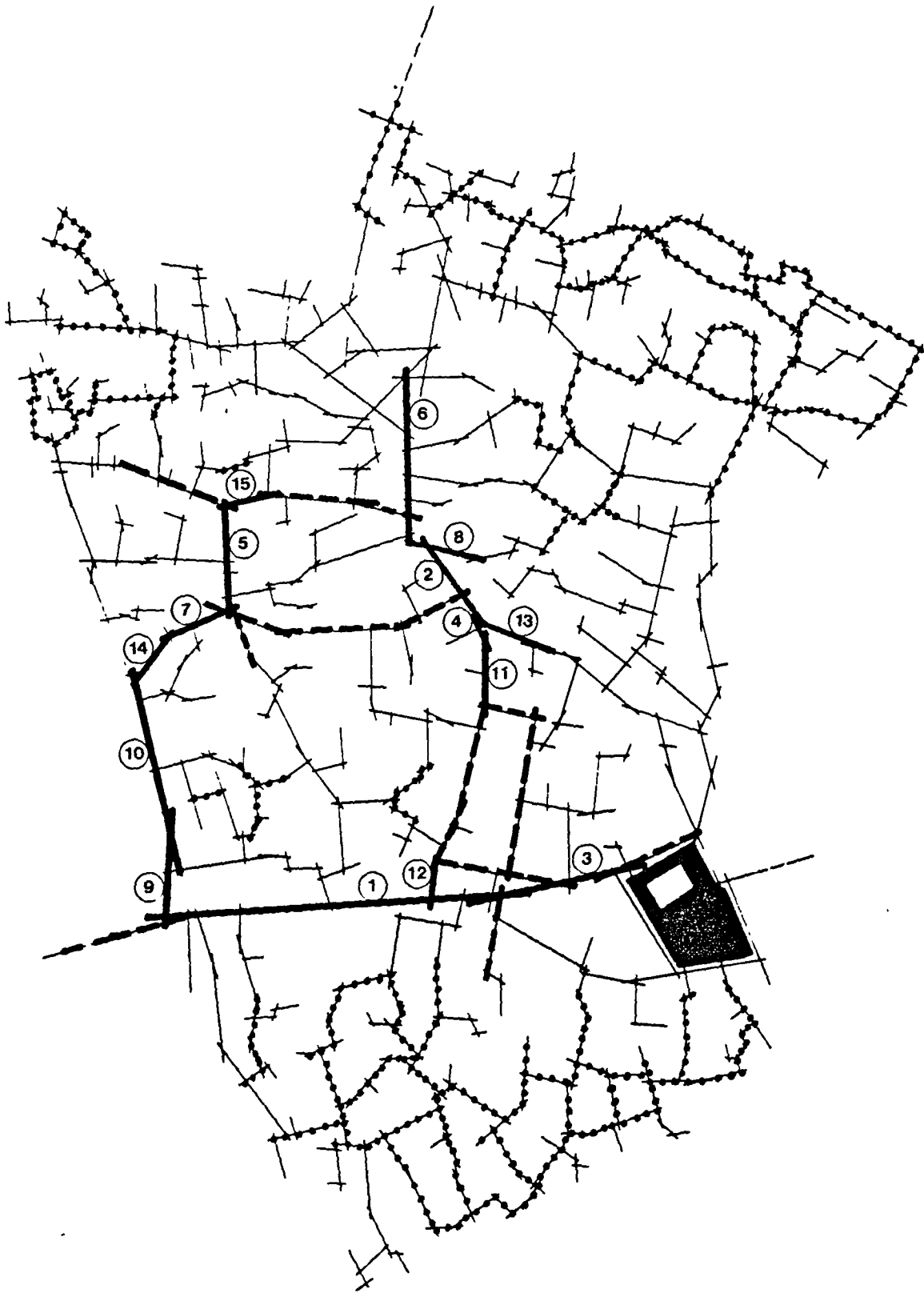
The map in Figure 3.29 shows the choice structure and the resulting path of the randomly generated journeys from the outside. The strong choice lines form two clusters, one of which strongly links the market place and the great mosque to the periphery; the other runs orthogonally from the market place towards the citadel, as in Algiers. The first and fourth strong choice lines intersect at the "Petit Socco" place, while the second develops in the vicinity of the citadel.

Similarly to the choice structure, the best spaces in the random journeys from the outside form two main clusters, one developing in the vicinity of the citadel, the other along the main market street. However, the correlation (0.4401) between the choice and random journeys indicates a poor interface between the two spatial quantities. The graph resembles strongly the one of Sale, in that there is a split between the best spaces of the two measures, but also a linear cluster in the middle (see scattergram in Appendix 2).

The above results indicate that the dead-end spaces affect strongly the level of integration of the market place and the mosque, in favour of the spaces constituting the "route" leading to the citadel. This suggests that the high integration of the great mosque and the market place is more related with the distributed system than the whole street network, that is to include the dead-ends. In fact, this is the opposite result to Algiers' structure, where the market streets become the best integrators (1st, 3rd, 5th and 7th) only in the system with the dead-end passages. The highly asymmetric grid structure of Tangier presents another strong similarity to Algiers, in that the integration cores form a deep ring linking market streets to the citadel and to the outside on two sides of the town.



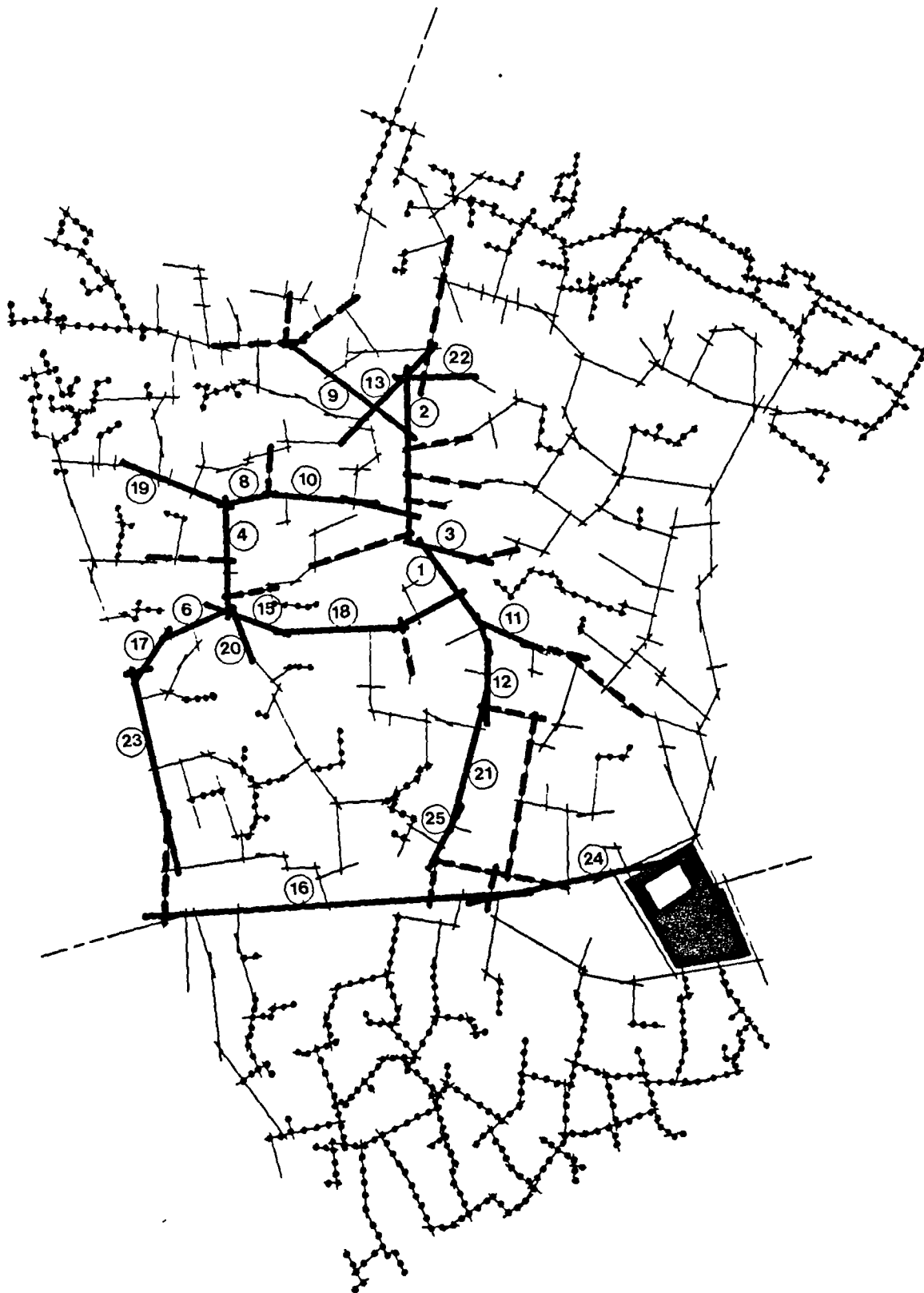
TANGIER
FIG. 3.25: AXIAL MAP
 — Market Streets



TANGIER

FIG. 3.26: INTEGRATION CORE (TA.1)

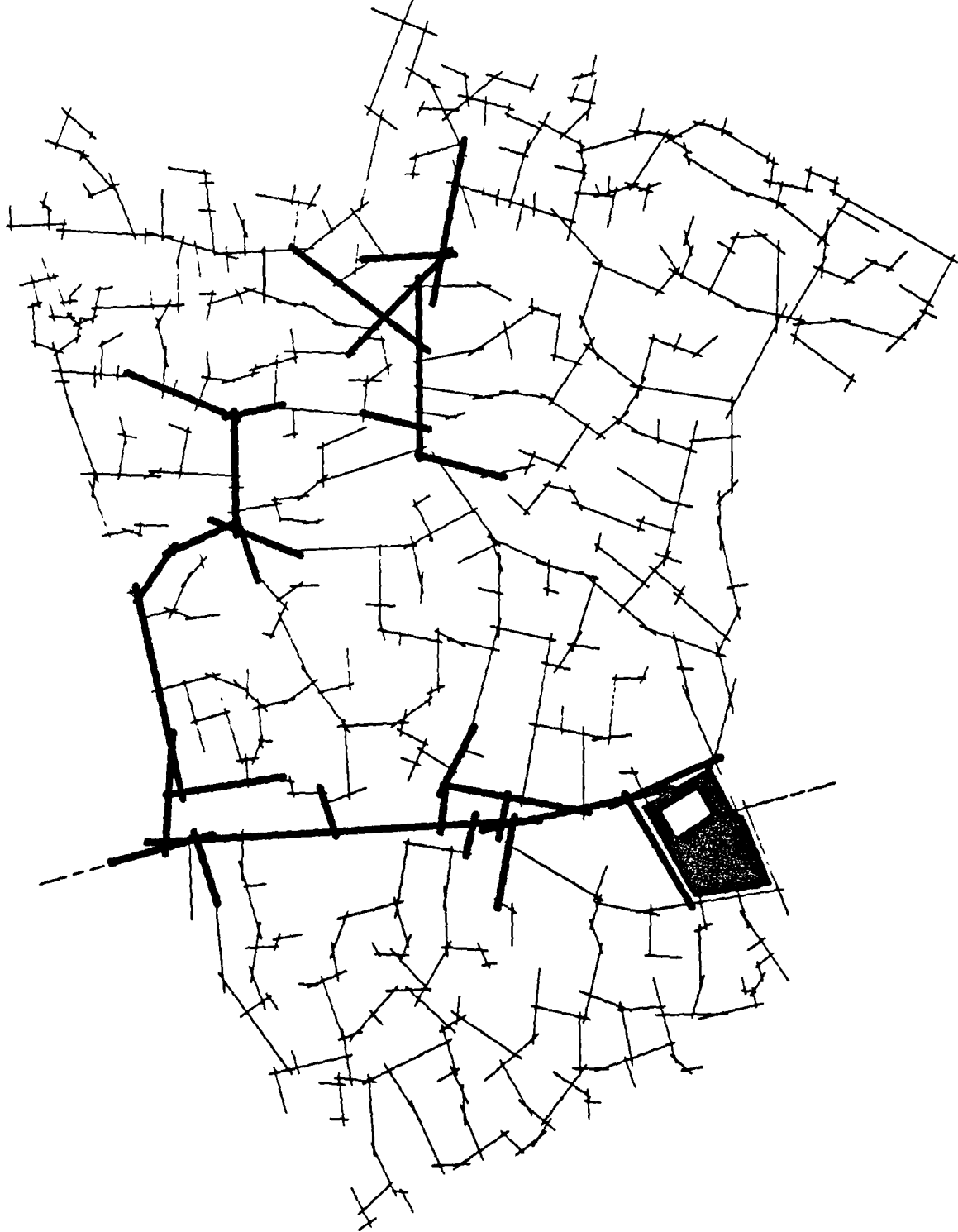
- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines

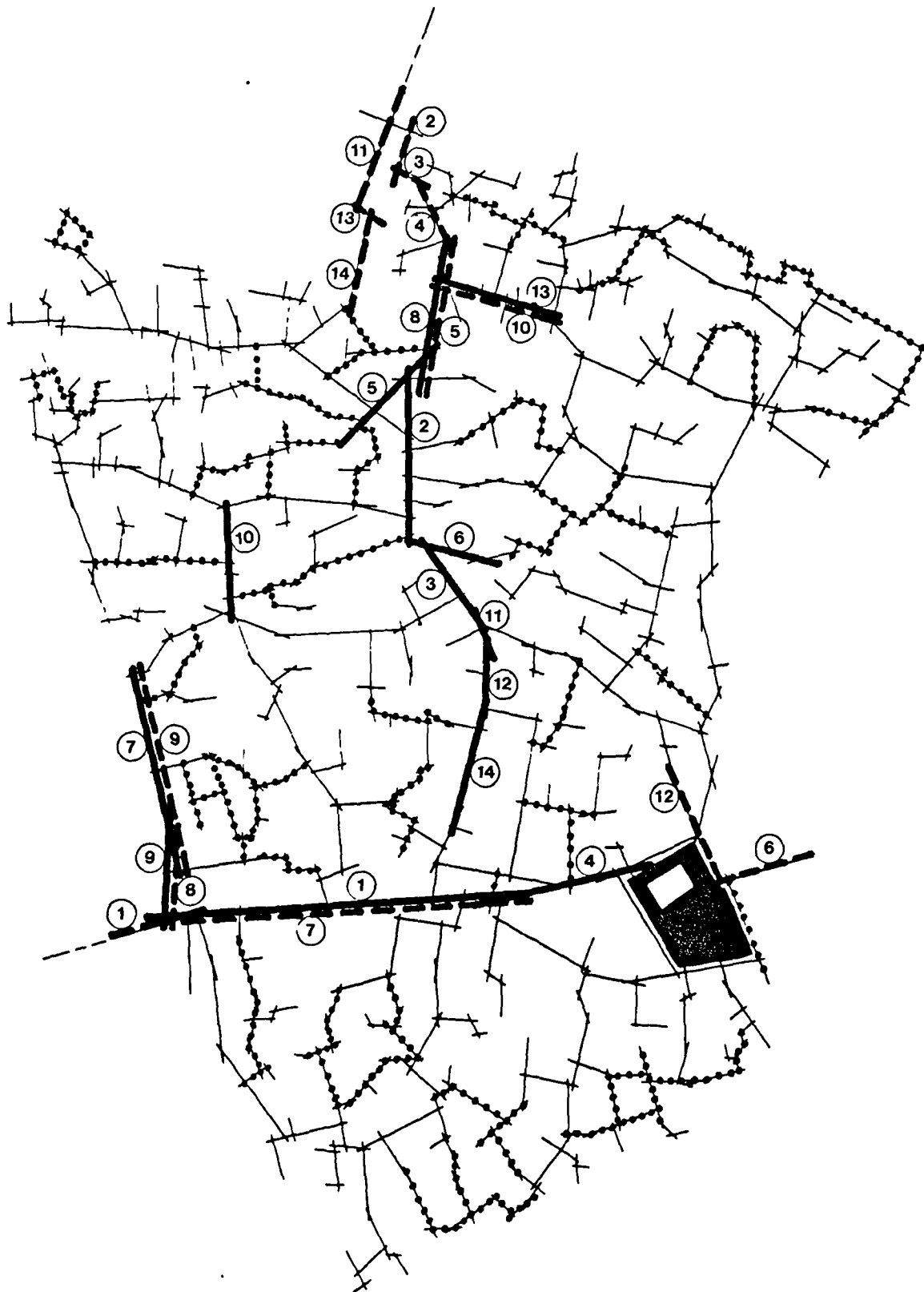


TANGIER

FIG. 3.27: INTEGRATION CORE (TA.2)

- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines

**TANGIER****FIG. 3.28: RADIUS-3 INTEGRATION CORE (10%)**



TANGIER

FIG. 3.29: CHOICE AND JOURNEY PATHS

— 25% of strong choice lines
 - - - Strong journey lines (equal number to strong choice lines)

THE TOWN OF CONSTANTINE:

The urban grid of Constantine presents some similarities to the last case, but also individual distinctive features. As in Tangier, the axial grid shows a great deal of deviation of the lines from the right angle geometry. The town's gates in this town are not strongly axially linked to the outside, such that there is no obvious longer lines which directly penetrate into the interior of the town from the outside as for example in Susa (see fig. 3.30). But, the urban grid of Constantine seems to present a regular feature characterized by the way in which the blocks are assembled according to their size. In many instances, a limited number of small blocks appear to be surrounded by much larger ones, forming a kind of a star-like or radial pattern. How this topological feature might affect the spatial structure of the town remains to be seen in the following sections.

The axial structure of this town seems to display a comparatively lower number of non-distributed lines than Tangier. This can be seen from a lower ratio (1.378) of the total number of axial lines (K2) against the number of distributed lines (K1) of the system; the mean depth of these lines being also lower (1.503) than in Tangier, but higher than Susa or Sale (see Table 3.1, p. 167).

SPATIAL PROPERTIES OF THE QUARTERS:

	C.1 whole town	Q.C.1 El-tabia	Q.C.2 El-jabia	Q.C.3 Kantara	Q.C.4 Casbah	Q.C.5 Suqs	MEAN of quarters
K	399	102	127	123	41	60	90.6
MEAN CN	2.842	2.745	2.551	2.699	2.634	2.866	2.699
MAX. CN	8.00	6.00	5.00	6.00	6.00	7.00	6.00
MEAN RRA	1.896	1.563	1.922	1.597	1.347	1.288	1.543
MAX. RRA	2.760	2.141	2.846	2.519	1.855	2.328	2.338
MIN. RRA	1.360	1.083	1.251	1.122	0.910	0.718	1.017
ST. DEV.	0.296	0.230	0.354	0.340	0.232	0.370	-
1:RA/CN	0.300	0.290	0.350	0.510	0.640	0.760	0.510
RELINT.	-.249	-.396	-.316	-.159	-.124	+.026	-.194
1:RA/RCH	0.470	0.780	0.760	0.660	0.640	0.600	0.688
REL	-.135	+.039	+.039	-.063	-.178	-.186	-.070
CN/CH	0.500	0.380	0.400	0.620	0.660	0.620	0.536
CV/CH	0.370	0.360	0.300	0.470	0.580	0.510	0.444

TABLE 3.10: FIRST AND SECOND ORDER MEASURES OF THE QUARTERS AND THE TOWN OF CONSTANTINE

Table 3.10 gives the analytical measures of the quarters taken separately and the town taken as a whole. It shows a great variation between the quarters with regard to their size given by the number of axial lines. The mean connectivity of the quarters varies from one to the other; and the mean of the means (2.699) remains below the mean of the town as a whole. The mean of the maximum connectivity of the five quarters is also below the maximum connectivity of the whole.

The mean integration of the quarters tends also to vary, but the mean of the means (1.5434) is higher than the mean of the town taken as a whole, unlike Tunis where the level of integration of the whole is

maintained at about the same level as the mean of the quarters. The "Suqs" quarter (Q.C.5) has the best level of integration of all, while "Bab-el-jabia" (Q.C.2) has the highest maximum segregation (max. RRA). However, it remains in all cases well below the urban average (0.9337).

The mean relative intelligibility of the five quarters (-0.194) is higher than the one given by the town taken as a whole, but remains very low, reaching the lowest level in quarter Q.C.1. The relative intelligibility of the "Suqs" quarter (Q.C.5) is the only one above average (+0.0267), but this quarter presents the lowest movement interface of all. The mean value of relative movement interface ($1:RA/RCH$) of the five quarters is also higher than the one given by the town as a whole. On the other hand, the mean of the local predictability (CN/CH) of the quarters is fairly close to the value shown by the whole town. This correlation varies between the quarters, with two of them being less predictable than the whole. These two quarters (Q.C.1 and Q.C.2) show also the lowest interface potential. These two quarters have consistently shown a very low level of integration, the lowest level of intelligibility, the highest movement interface and the lowest local predictability of all. These results seem to indicate a certain differentiation in the structuring of the parts, which may be seen to point to the existence of a "local character" of a particular type in this town. The whole town is markedly more segregated than any of all previous towns, and is far more segregated than most (not all) of its parts.

At this stage, it seems that the system of Constantine when taken as a whole, seems to increase but only slightly, both its mean and

maximum connectivity, while becoming more segregated than most of its parts and maintaining a low intelligibility and movement interface. The central quarter which contains most of the market streets is by far the most integrated and the most intelligible, but presents the lowest movement interface.

The cores of the five quarters are presented in Figure 3.31 which shows:

- in "Tabia" (Q.C.1), a linear and central core which traverses the quarter and links to both the outside and to the "Suqs" quarter;
- in "Al-Jabia" (Q.C.2), a compressed core with a central ring which does not connect to the periphery, nor to the "Suqs" quarter;
- in "Kantara" (Q.C.3), a central but less denser core connecting, but not strongly, to the "Suqs" quarter;
- in the "Casbah" quarter (Q.C.4), a linear and central core strongly connected to the outside and to the "Suqs" quarter;
- in the "Suqs" quarter (Q.C.5), a relatively more covering core expanding in the direction of the other quarters and linking 3 out of 4 quarters.

The combination of the five cores (see fig. 3.31) shows no continuous link between the integrated spaces of the separate quarters, although 4 cores out of 5 are only few spaces (2 to 3 lines) away from each

other. The resulting structure is less covering when compared to Tunis or Sale.

THE SPATIAL PROPERTIES OF THE TOWN AS A WHOLE:

	C.1	C.2	C.3
K	399	550	372
MEAN CN	2.8421	2.6873	2.6989
MAX. CN	8.00	9.00	8.00
MEAN RRA	1.8968	1.8102	2.0135
MAX. RRA	2.7600	2.7300	3.1800
MIN. RRA	1.3600	1.2800	1.3600
ST. DEV.	0.2964	0.2941	0.3946
1:RA/CN	0.3000	0.3300	0.3700
REL. INTELL.	-.2495	-.1818	-.1873
1:RA/RCH	0.4700	0.4800	0.4400
REL	-.1351	-.0886	-.1727
CN/CH	0.5000	0.5700	0.4800
CV/CH	0.3700	0.3700	0.2500

TABLE 3.11: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF CONSTANTINE

The above table and Table 3.1 in page 167 indicate that Constantine has a lower mean connectivity than the towns presented earlier, except for Tangier (2.752); but has the lowest maximum connectivity of all, which remains so when the peripheral streets are omitted

(C.3). The results indicate also the lowest mean integration compared to all other towns, which decreases when the peripheral streets are removed (C.3) as in Sale or Tunis but not so much as in Susa; it remains fairly the same when the cul-de-sacs are added (C.2). The maximum segregation (MAX. RRA) is very high compared to the urban average (1.5316) and becomes exceptionally higher when the peripheral streets are omitted (3.18).

The town has also a very low level of relative intelligibility compared to Tunis, Sale or Susa and is even lower than the intelligibility of Tangier (-0.205); it shows a marginal improvement when the dead-end passages are taken into account (C.2) and when the peripheral streets omitted (C.3). The system has also the lowest movement interface of all (see Table 3.1, p. 167), which improves when the dead-ends are added (C.2); but decays in the system considered without the peripheral streets (C.3). The grid structure of Constantine is also characterized by the lowest local predictability and interface potential (see also Table 3.1, p. 167).

Figure 3.32 shows the 5% and 10% most integrated spaces of the grid (C.1). The 1st and 2nd most integrated spaces run along the market streets, while the 4th, 6th and 7th which also run along the market streets, connect these latter to the great mosque. In fact, most (15 lines out of 20) of the 5% most integrated spaces correspond to the market streets. The core forms a dense cluster in the central part of the town without connecting to the outside. The integration core by its position leaves large areas of the town uncovered. The most segregated spaces form three clusters around the integration core, two of which constitute two distinct segregated zones in the "El-

Jabia" (Q.C.2) and "Kantara" (Q.C.3) quarters (see fig. 3.31). All four gatelines form part of the segregated spaces.

The integration core of the system taken with the dead-end passages (C.2) develops also in the central part, and unlike the core of C.1 it connects to the periphery but not strongly (see fig. 3.33a). The market streets are also the most integrated spaces in C.2 (system with the dead-ends). In this case also almost all spaces of "El-Jabia" quarter (Q.C.2) form part of the most segregated spaces. Most of the dead-end passages (84%) are also segregated. When the peripheral streets are removed (C.3), the core shown in Figure 3.33b, does not present major variation from the core of C.1 in terms of location, overall shape and order of integration of the first seven best integrators.

Radius-3 integration core in Figure 3.34 shows that some spaces which are strongly segregated with respect to the system as a whole are at the same time strongly integrated locally. In addition to this, the structure of radius-3 core when compared to radius-n core, is more broken up and presents no dominant pattern by contrast to for example radius-3 core of Tunis. But, the structure of the combined core (see fig. 3.31) resembles radius-3 core and shows a certain degree of correspondence between the spaces of radius-3 core, and the spaces of the integration cores of the various quarters.

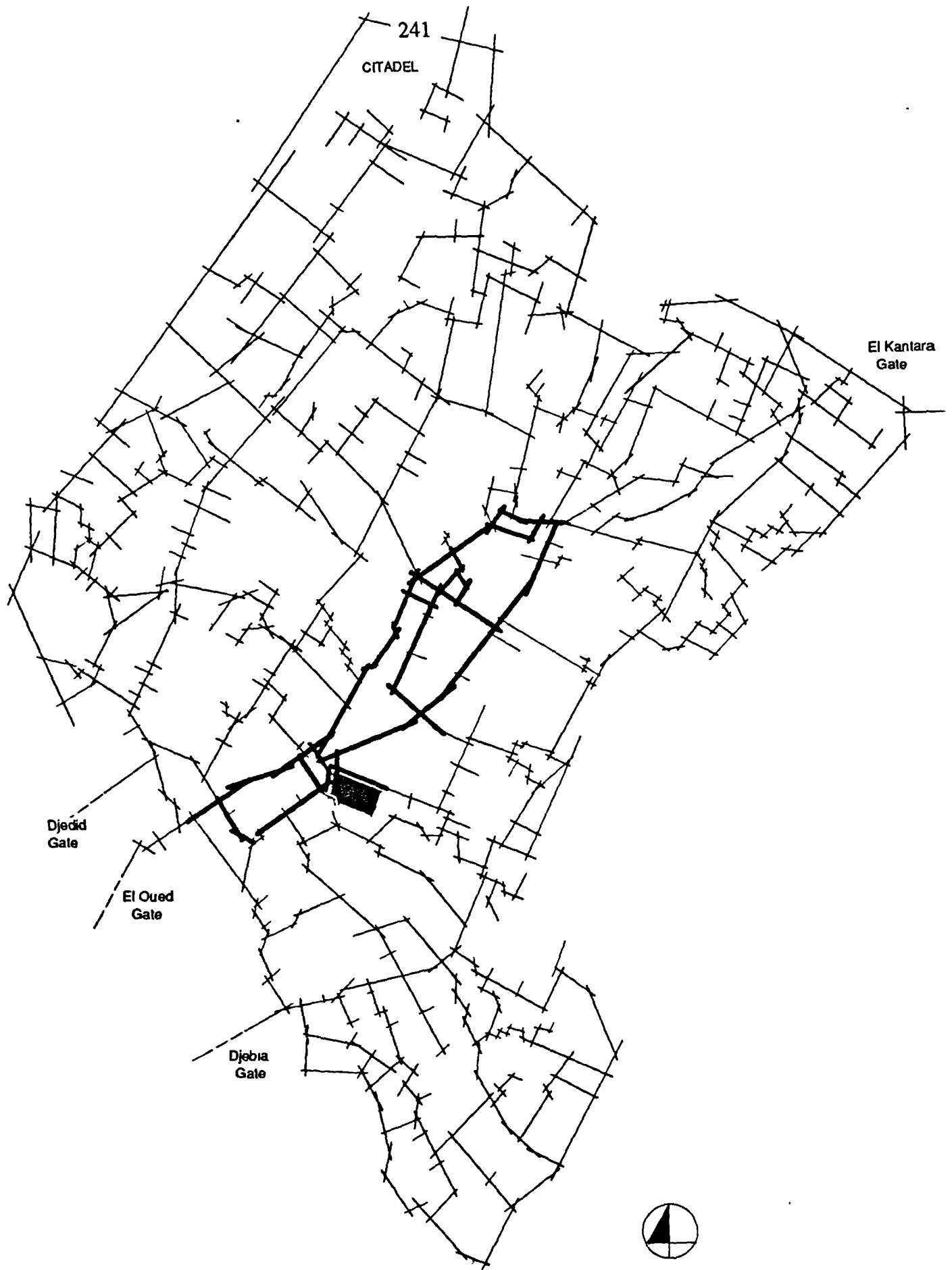
Figure 3.35a shows both the choice structure and the path resulting from the randomly generated journeys from the outside. The best lines in terms of choice include the market streets. The best spaces of the "random journeys" path form a dominant route running towards

the great mosque and the citadel, but away from the market streets. The choice path forms two main clusters, one developing in the central part of the town along the market streets and near the great mosque, the other running along the peripheral street in proximity of the citadel. The map (see fig. 3.35a) shows that there is almost no overlap between the two quantities, with a weak correlation of only 0.3324. The examination of the graph suggests a clear split between the two types of spatial measures (see scattergram, Appendix 2).

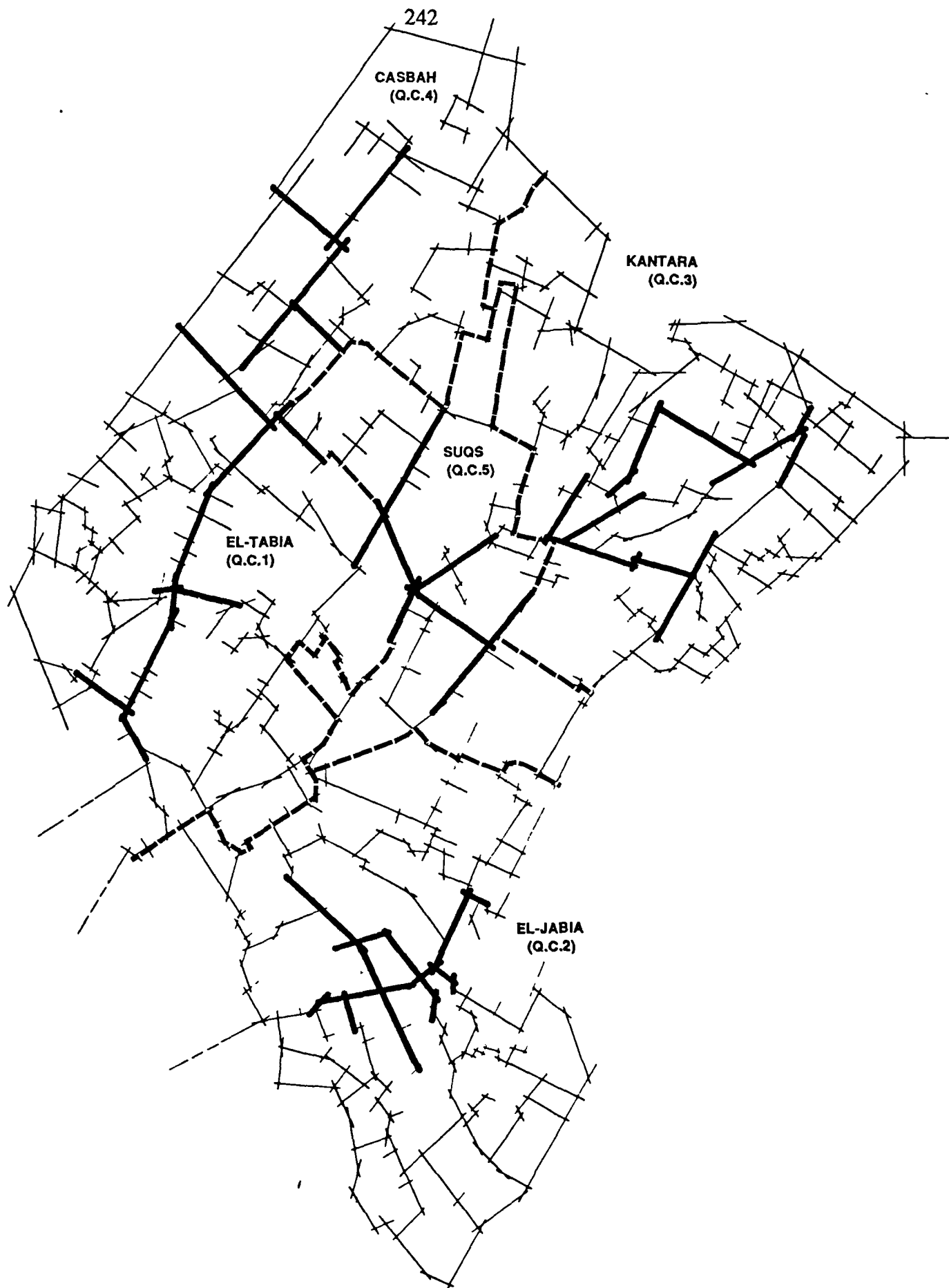
The choice structure shown in Figure 3.35b of the system without the peripheral streets (C.3) presents a "T-like" pattern in the central part of the system, along the market streets. The best choice lines (1st, 2nd and 4th) are along these streets. The emerging path from the random journeys from the outside splits into two branches, one running along the market streets and the great mosque, the other across "El-Tabia" quarter (Q.C.1) towards the citadel (see fig. 3.35b). The map shows a stronger overlap between the two paths of choice and random journeys, essentially taking place along the market streets. The correlation (0.5459) of the two quantities shows a better interface than in the previous version C.1.

From this, it seems that the peripheral streets in constantine tend to affect more the choice structure than the journeys or the integration core, suggesting then that the peripheral streets seem to play a certain role in controlling the interface between the global choice inside the system and the random journeys logged in from the outside represented as a single entity.

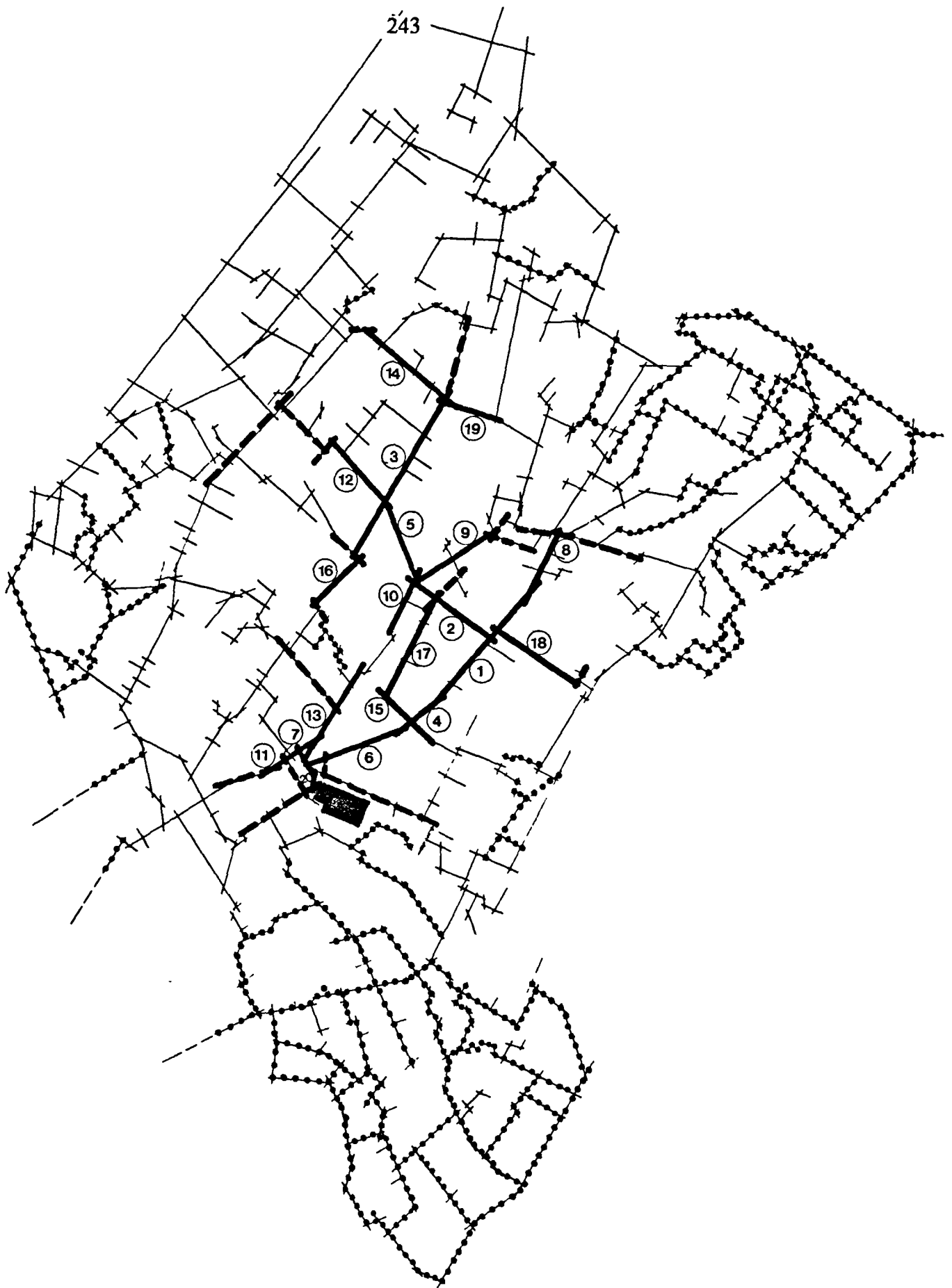
The spatial analysis of the grid structure of Constantine points to some general conclusions which are: firstly, the town grid is characterized by a central and clustered type of core not connecting to the outside, and essentially extending along the main market streets, including the great mosque; secondly, the town has the most segregating grid structure and the lowest level of relative intelligibility and movement interface; thirdly, when taken as a whole, the town becomes more segregated and less intelligible than most of its parts, suggesting therefore a lack of a super-structure as seen in Tunis or Sale; and finally, the local spatial structure given by radius-3 integration core is more broken up, failing then to link or define the quarters.



CONSTANTINE
FIG. 3.30: AXIAL MAP
— Market Streets



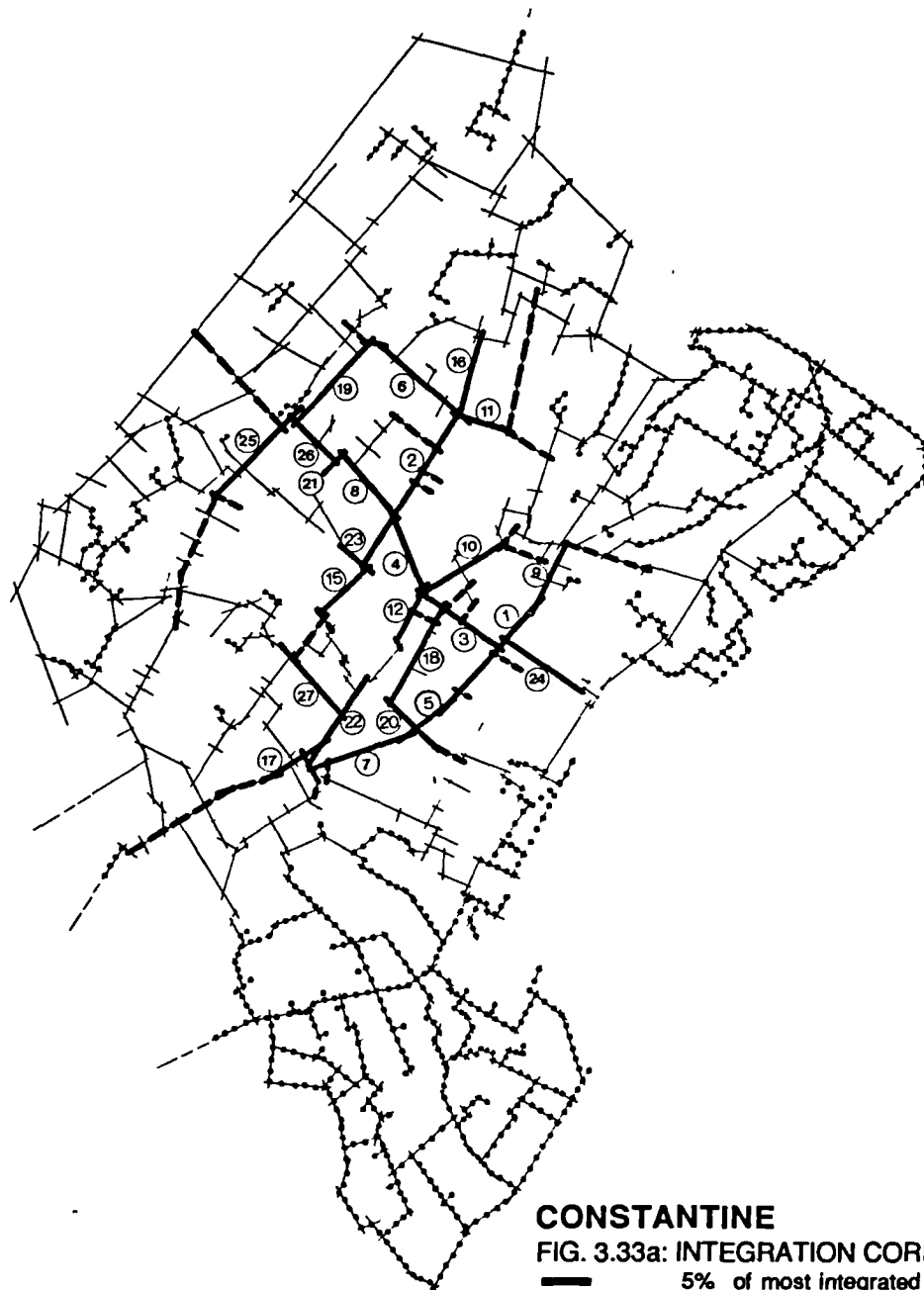
CONSTANTINE
FIG. 3.31: INTEGRATION CORES (QUARTERS)
— 10% of most integrated lines



CONSTANTINE

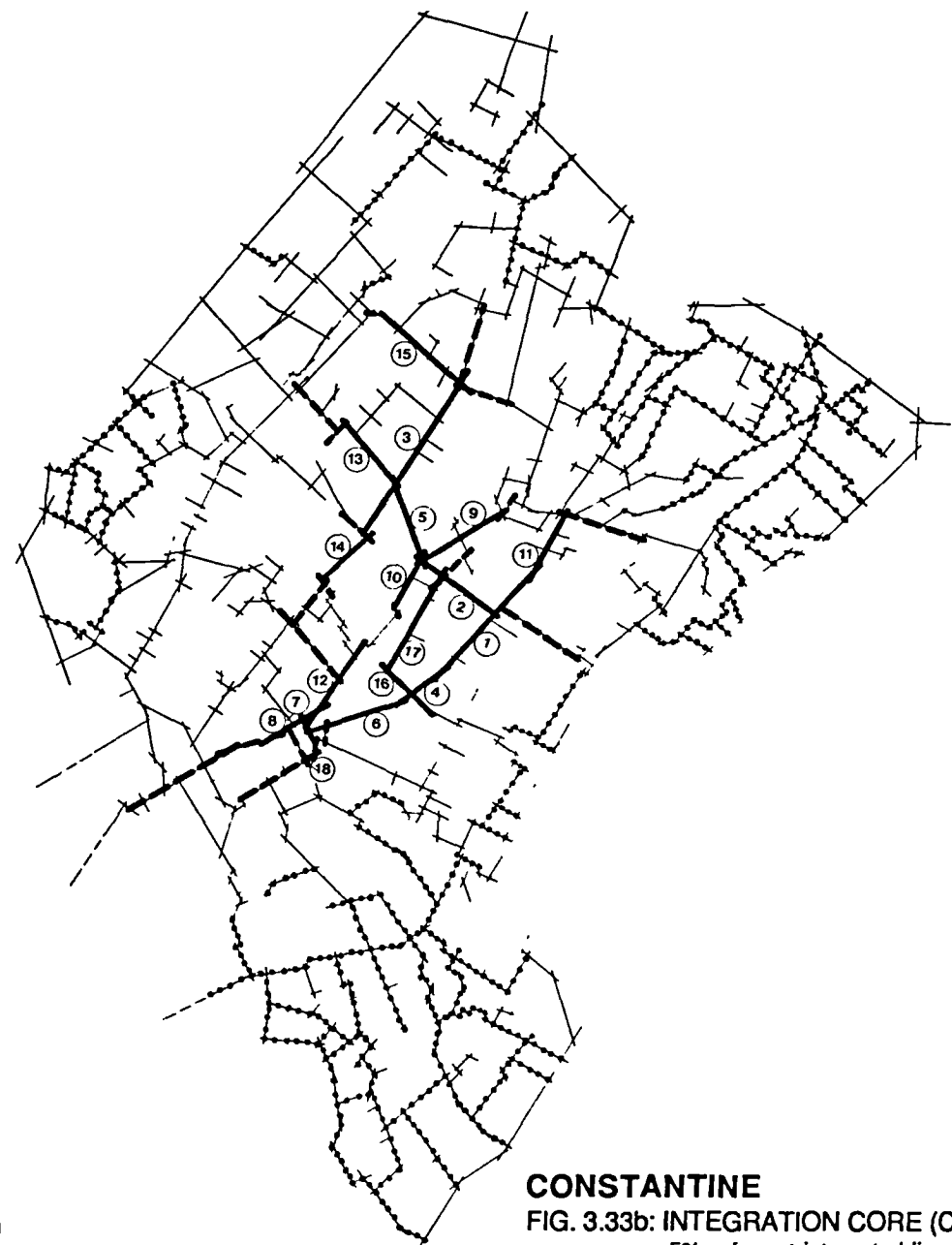
FIG. 3.32: INTEGRATION CORE (C.1)

- 5% of most integrated lines
- - - 10% of most integrated lines
- ... 50% of most segregated lines



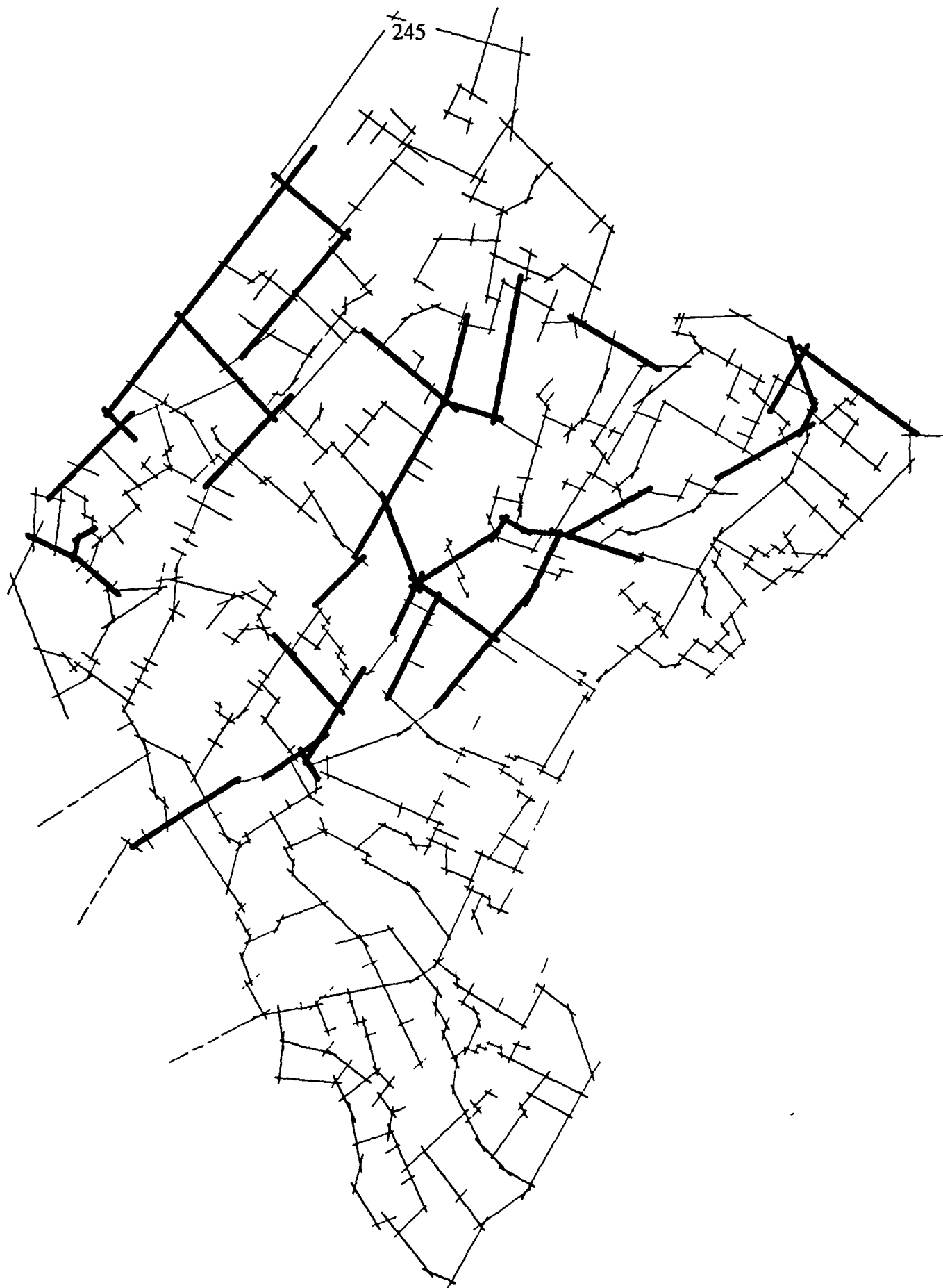
CONSTANTINE
 FIG. 3.33a: INTEGRATION CORE (C.2)

- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines

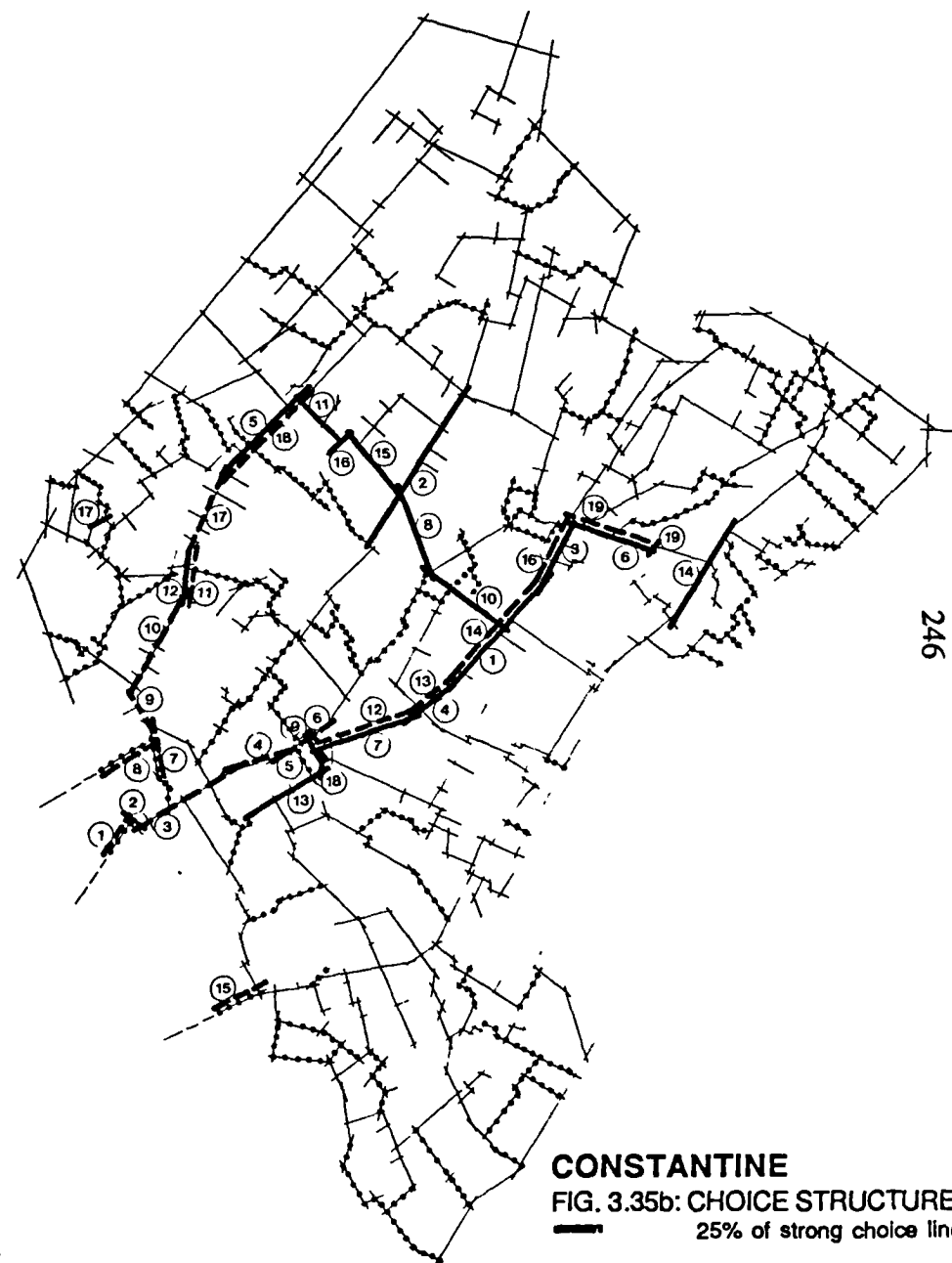
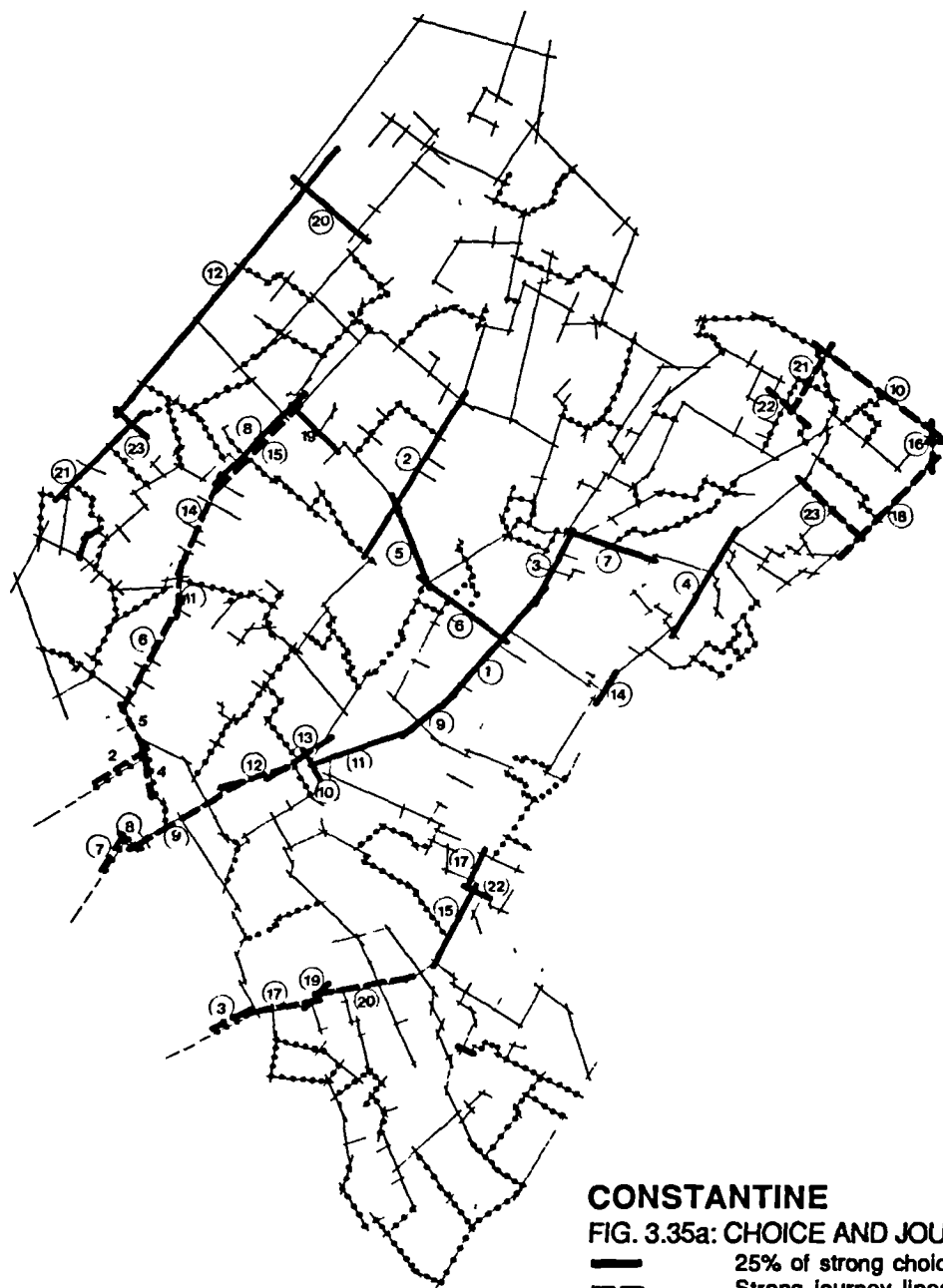


CONSTANTINE
 FIG. 3.33b: INTEGRATION CORE (C.3)

- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines



CONSTANTINE
FIG. 3.34: RADIUS-3 INTEGRATION CORE (10%)



THE TOWN OF MEKNES:

In this town, the number of non-distributed lines representing the dead-ends is higher than in any previous case, amounting to about half of the total number of axial lines (ratio of total number of axial lines against number of distributed lines = 1.993). These dead-end lines have also the second high mean depth (1.6867) after Tangier (see Table 3.1, p. 167). The overall axial structure of Meknes appears in many respect similar to that of Algiers and Tangier especially in the narrow angles of line intersections. One individual feature of the axial grid of Meknes in Figure 3.36 is the structure of the eastern edge of the system, which is composed by relatively longer lines, one of which being the longest line of the system. These lines tend to interlink at wider angles and form a kind of dominant routes running north-south and linking to two town's gates. Inside the two peripheral axial routes, the axial lines become shorter and intersect at more regular angles (see fig. 3.36). The axial structure at the northern and southern periphery is more broken up, with many lines in the form of dead-ends. But, unlike the axial grid of Algiers where the market area presents a marked and distinct axial structure, the internal axial structure of Meknes appears to be uniformly constructed.

SPATIAL PROPERTIES OF THE QUARTERS:

	M.1	Q.M.1	Q.M.2	Q.M.3	Q.M.4	Q.M.5	Q.M.6	Q.M.7	Q.M.8	Q.M.9	MEAN
K	267	30	52	45	59	48	47	35	22	22	40
MEAN CN	3.026	2.866	2.576	2.666	2.915	2.750	2.936	2.628	2.363	3.000	2.744
MAX. CN	9.00	5.00	5.00	5.00	4.00	5.00	6.00	4.00	4.00	9.00	5.220
MEAN RRA	1.415	1.032	1.338	1.145	1.322	1.396	1.092	1.273	1.379	0.753	1.192
MAX. RRA	2.087	1.497	1.989	1.492	1.860	2.130	1.450	1.981	1.933	1.022	1.705
MIN. RRA	1.027	0.626	0.862	0.720	0.890	0.906	0.683	0.807	0.866	0.377	0.748
ST. DEV.	0.213	0.231	0.265	0.206	0.260	0.313	0.204	0.308	0.325	0.158	-
1:RA/CN	0.450	0.680	0.680	0.590	0.460	0.550	0.680	0.700	0.800	0.790	0.659
REL. INTE.	-.143	-.109	-.065	-.167	-.272	-.201	-.073	-.077	-.013	-.023	-.111
1:RA/RCH	0.620	0.880	0.790	0.810	0.800	0.700	0.790	0.830	0.820	0.820	0.804
REL	-.027	+.036	-.086	-.067	-.015	-.105	-.017	-.001	-.047	-.047	-.0380
CN/CH	0.610	0.790	0.790	0.780	0.580	0.580	0.640	0.770	0.720	0.940	0.731
CV/CH	0.440	0.610	0.550	0.590	0.430	0.460	0.540	0.540	0.480	0.920	0.569

TABLE 3.12: FIRST AND SECOND ORDER MEASURES OF THE 9 QUARTERS OF MEKNES

The results of the analyses of the quarters are set up in Table 3.12 which shows:

- the mean of the connectivity (mean and maximum) of the quarters is well below the connectivity of the town taken as a whole. Many quarters have a higher level of integration than the whole town and some are markedly so; others have about the same integration; but in no case, have they emerged more segregated than the whole.
- the mean relative intelligibility is low and remains fairly close to the intelligibility of the town taken as a whole. The relative intelligibility of Q.M.4 and Q.M.5 is exceptionally low. But, the mean value of relative movement interface of the quarters is about

average as is also the case of the whole town, although it is very low in Q.M.5 and Q.M.2. The mean value of both, local predictability and interface potential is higher than in the town as a whole. The peripheral quarter Q.M.9 has an exceptionally high local predictability and interface potential (0.94; 0.92 respectively).

The integration cores of the quarters of Meknes in Figure 3.37 present two types:

- a linear traversing structure as in Q.M.6, Q.M.8, Q.M.4; or a linear structure connected on one side to the periphery as in Q.M.7, Q.M.9, Q.M.3 and Q.M.1;
 - a peripheral structure with penetrating lines as in Q.M.2 and Q.M.5.
- But, despite the small sizes of the quarters, the local integration cores remained confined to one particular part of the small systems. Moreover, the combination of these local cores does not show any tendency to form a global structure as for example in Tunis.

This town has shown strong differentiation in the grid structure of its parts, given by the above measures. For example, the quarters Q.M.5 and Q.M.9 have consistently shown the opposite properties. Therefore, no consistent pattern seems to emerge from the analysis of the parts, although the town when taken as a whole, seems to increase its maximum connectivity but also its level of segregation. The increase of the maximum connectivity in Meknes does not seem to be efficacious to control the effects of size as only one line in the system (in Q.M.9) has nine connections, excluding the dead-ends. The lack of improvement in the level of intelligibility of the whole

system also points to the conclusion that Meknes, when considered as a whole, does not seem to develop any properties of the "super-grid" structure as seen in Tunis. This will be further examined in the following sections.

SPATIAL PROPERTIES OF THE GLOBAL SYSTEM:

	M.1	M.2	M.3
K	267	532	258
MEAN CN	3.0262	2.6429	2.9767
MAX. CN	9.00	10.00	9.00
MEAN RRA	1.4156	1.3934	1.4912
MAX. RRA	2.0875	2.8145	2.2217
MIN. RRA	1.0274	0.9454	1.0592
ST. DEV.	0.2138	0.2409	0.2419
1:RA/CN	0.4500	0.4700	0.4100
REL. INTELL.	-.1432	-.0459	-.1868
1:RA/RCH	0.6300	0.5600	0.6200
REL	-.0178	-.0125	-.0313
CN/CH	0.6100	0.6800	0.6200
CV/CH	0.4400	0.5000	0.4600

TABLE 3.13: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF MEKNES

The above table shows that the level of integration of Meknes is relatively low when compared to towns like Tunis, Sale or Susa, but is higher than towns like Algiers, Tangier and Constantine (see also Table 3.1, p. 167). when the peripheral streets are omitted, the level of integration decreases slightly as in Tunis, Sale and Constantine, but not so much as in Susa. The maximum segregation (max. RRA) increases substantially when the dead-ends are considered (M.2).

The results indicate a poor level of relative intelligibility by contrast to Tunis, Susa or Sale, which improves significantly when the dead-ends are added (M.2). But, to say that the system with the dead-end passages is in real terms more intelligible, requires more research such as observations of real movement patterns, which is beyond the scope of the present study. However, using the spatial measures only, the system taken with the dead-end passages does present a higher intelligibility. The relative movement interface of the town on the other hand, approaches average and remains below the movement interface of Tunis or Algiers (see Table 3.1, p. 167); but the local predictability and interface potential are of the same order to the correlations of Tunis and are low compared to the average of the 75 urban systems (SERC Report, 1986, p. 11), and both improving slightly in the system looked at with the dead-end lines.

It is clear from the above results that the urban grid of Meknes does not connect strongly to its edges as the removal of the peripheral streets does not affect strongly the level of integration, intelligibility or movement interface of the system. It is also clear that the highly segregated grid structure of this system does not result from the dead-end street configuration. However, the dead-end system seems to have an influence on the intelligibility of the town.

The spatial analysis of Meknes showed striking properties regarding the structure of the integration core and the location of the most segregated spaces. The first two best integrators intersect at the market streets and strongly connect to the periphery (see fig. 3.38). The 3rd, 4th, 5th and 7th best lines form a linear route in the middle of the town, linking back to the periphery and to the outside. The

integration core shown in Figure 3.38 (M.1) forms a large ring running in the middle of the town and partly along the periphery, reminding the edge ring type of Susa. The core connects to the outside and extends along some commercial streets and runs close to the great mosque. The most segregated spaces cluster around the integration core, along the peripheral areas of the town. The map in Figure 3.38 shows two distinct areas of the town that are opposed to each other; one containing the integration core, the other forming a segregated "zone". When the dead-end passages are considered in the analysis of the town (M.2), the best integrators remain fairly the same as in the previous version (M.1). But, in version M.2, the core is denser and includes more market streets as well as the great mosque (see fig. 3.39a). The most segregated spaces remain along the edges of the town and include 86.4% of the total number of dead-end lines. When the peripheral streets are discounted (M.3), the core still connects to the periphery, but not to the outside (see fig. 3.39b). The overall shape and location of the core present strong similarities to M.1.

Radius-3 integration core shown in Figure 3.40, presents important differences compared to radius-n core (M.1). Radius-3 core presents a broken up structure as in Constantine and includes some lines constituting the integration cores of the quarters. But, there is an overlap between radius-3 and radius-n core (M.1) which takes place at the eastern part of the town, along the peripheral street and nearby the market streets. However, the structure of the combined core (see fig. 3.37) and radius-3 core suggests that the general trend of the local organisation in this system is not geared towards the development of a global pattern as seen in Tunis. Instead, the town

seems to be made up of a distinct global structure and parts that are relatively isolated from each other and from the global core.

The examination of the choice path in Figure 3.41a indicates one prevalent continuous structure which covers the main market streets and connects these latter to the outside and to the periphery. The choice structure is confined to one side of the town and excludes the great mosque. When the peripheral streets are discounted, the choice structure is no longer continuous with the best line remaining on the market street as in the previous case (see fig. 3.41b). The map in Figure 3.41a shows also the path resulting from the randomly computer-generated journeys from the outside. This forms small clusters nearby the gatelines, one of these clusters overlaps fairly strongly with the choice structure. The correlation between the two quantities (0.5696) may express only a certain degree of interface (see scattergram, Appendix 2) which appears from the spatial evidence alone, to take place in the market area and at the periphery of the town.

It is clear from the above results that the highly asymmetric structure of the grid of Meknes is strongly affected by size, as the system increases its level of segregation and becomes less intelligible when taken as a whole. The grid structure of Meknes is also characterized by a clear regionalization of the global core, forming an edge ring linking some market streets and mosque to the periphery. This regionalization is not created by the connections of the grid to its edges, nor by the presence of dead-end lines. The grid structure of Meknes showed no tendency to develop a global pattern out of the strong local lines, as seen in Tunis or Sale.

El Berdain
Gate

Djedid
Gate

Tizimi
Gate

Berrima
Gate

Zeine El Abidine
Gate

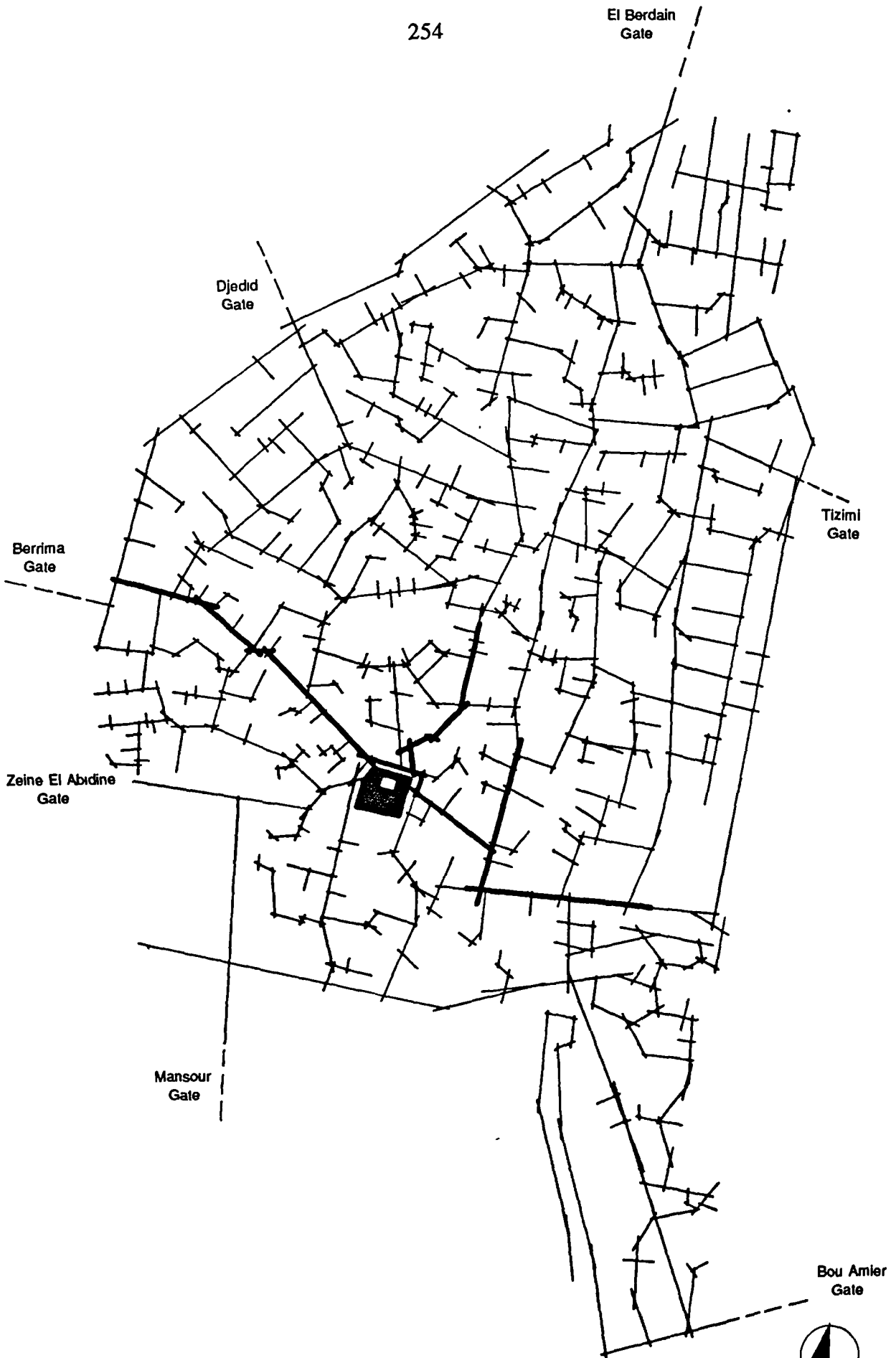
Mansour
Gate

Bou Amier
Gate



MEKNES

FIG. 3.36: AXIAL MAP
— Market Streets



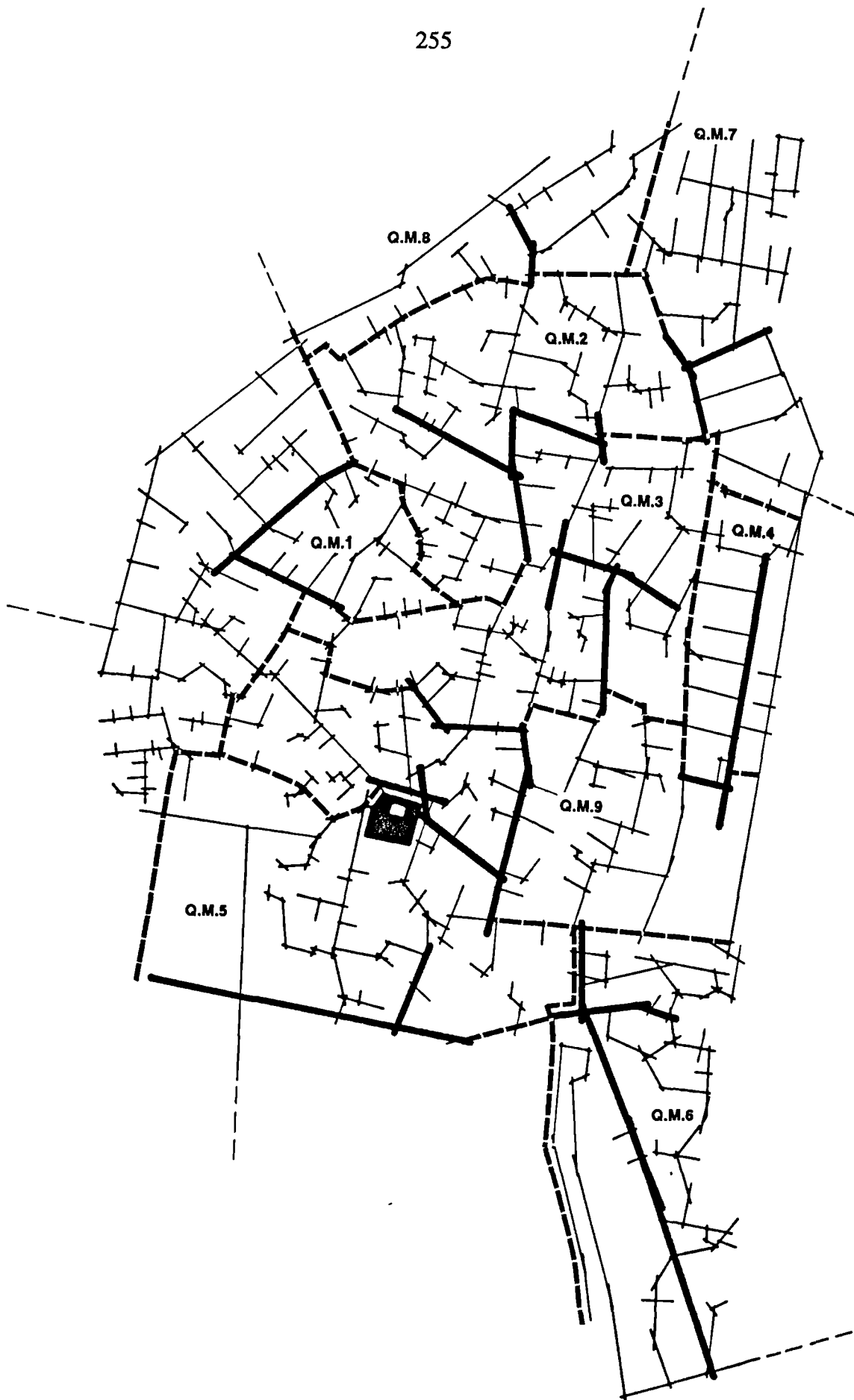
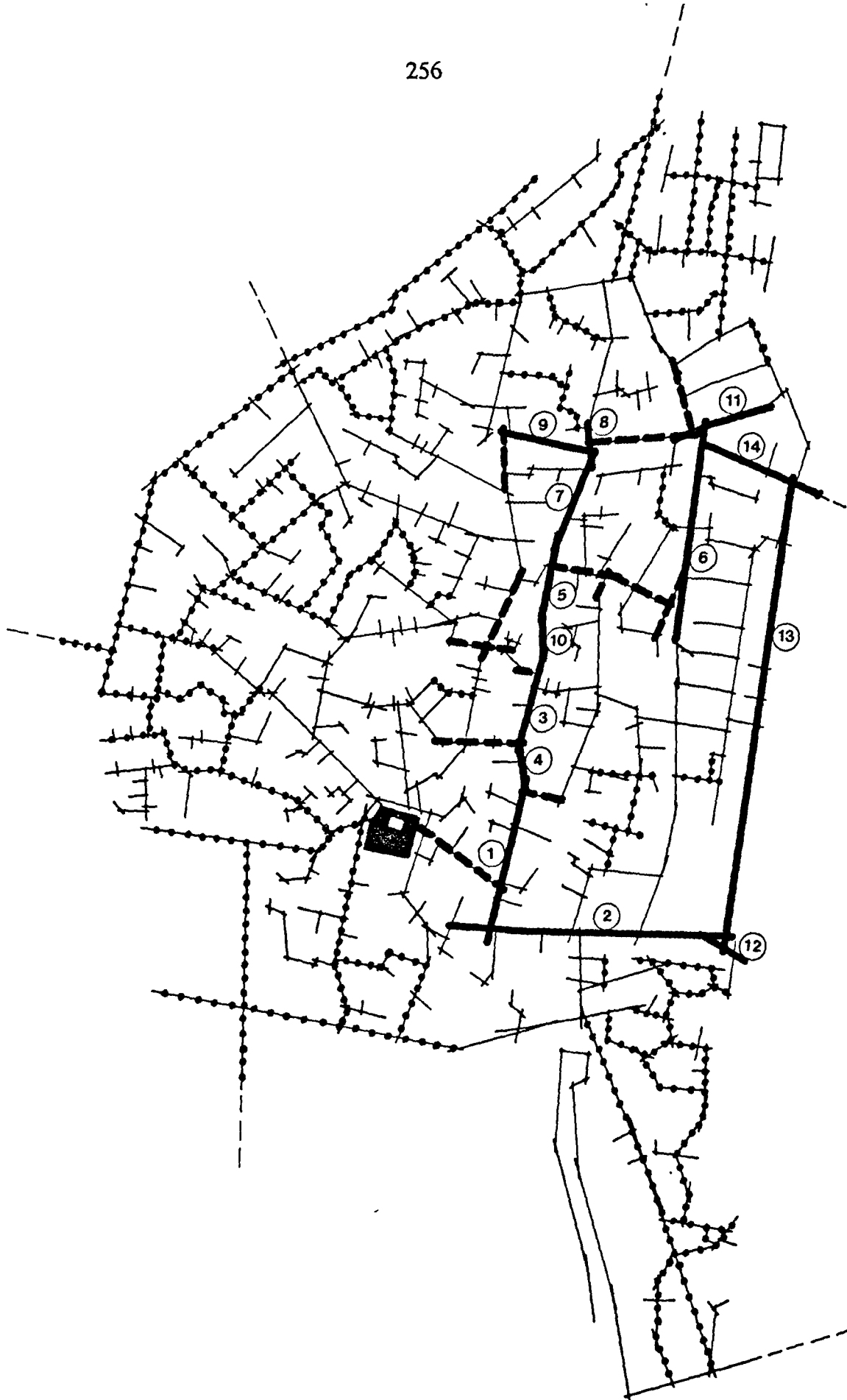
**MEKNES**

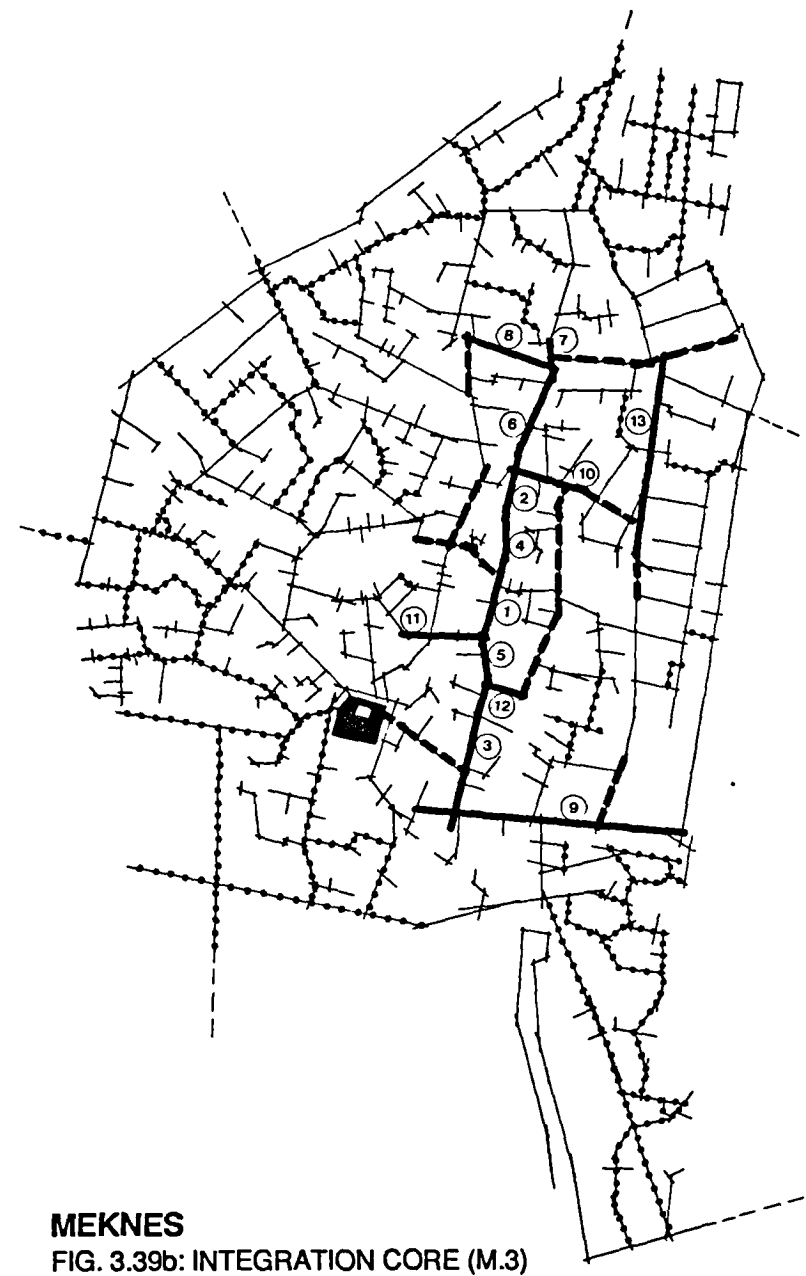
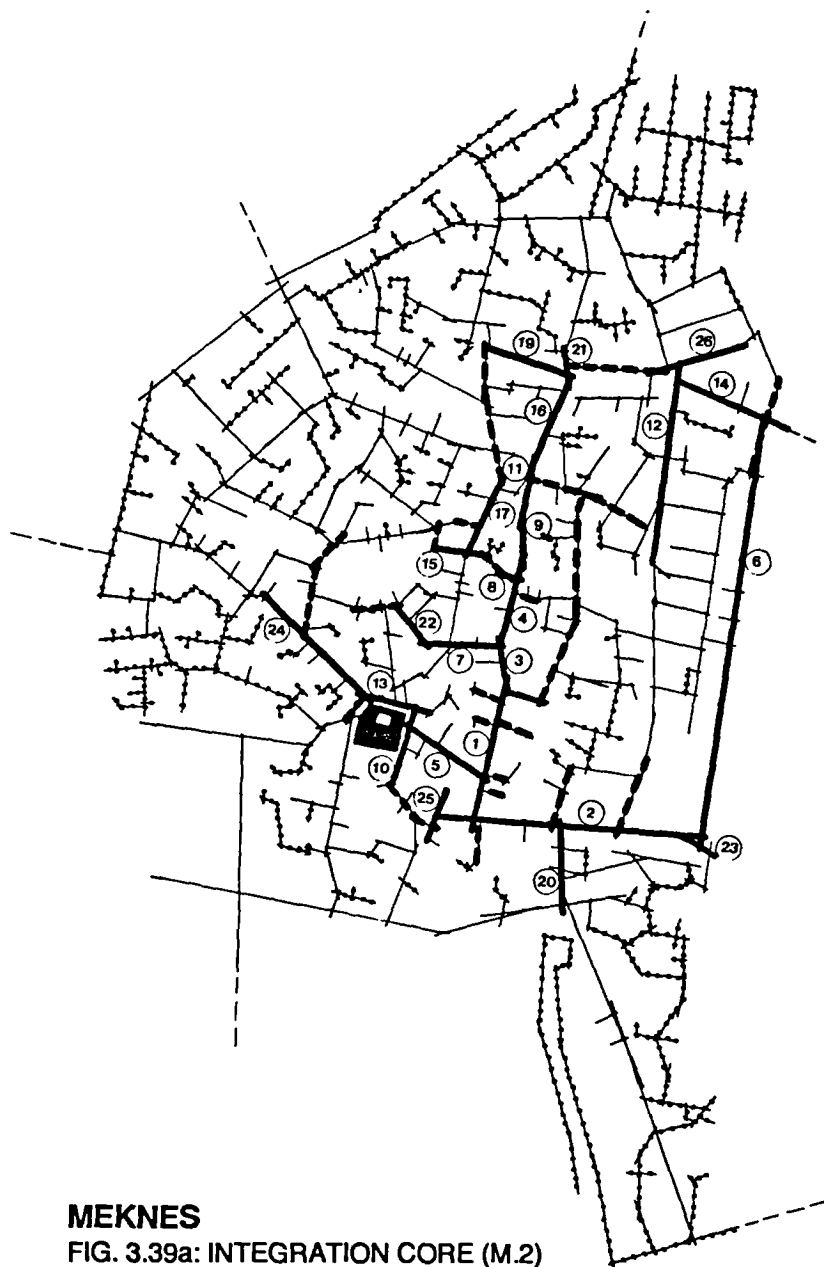
FIG. 3.37: INTEGRATION CORES (QUARTERS)
— 10% of most integrated lines

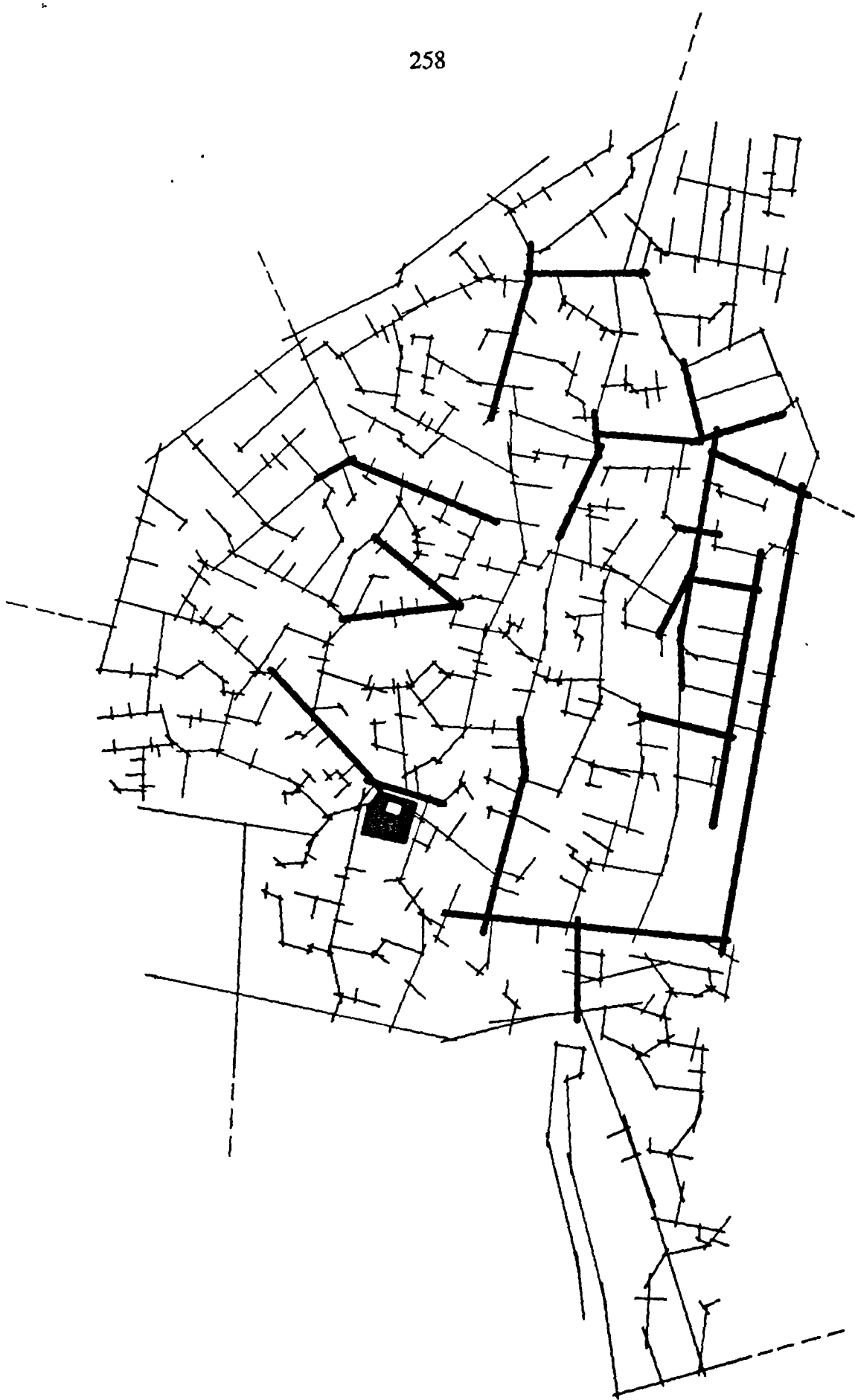


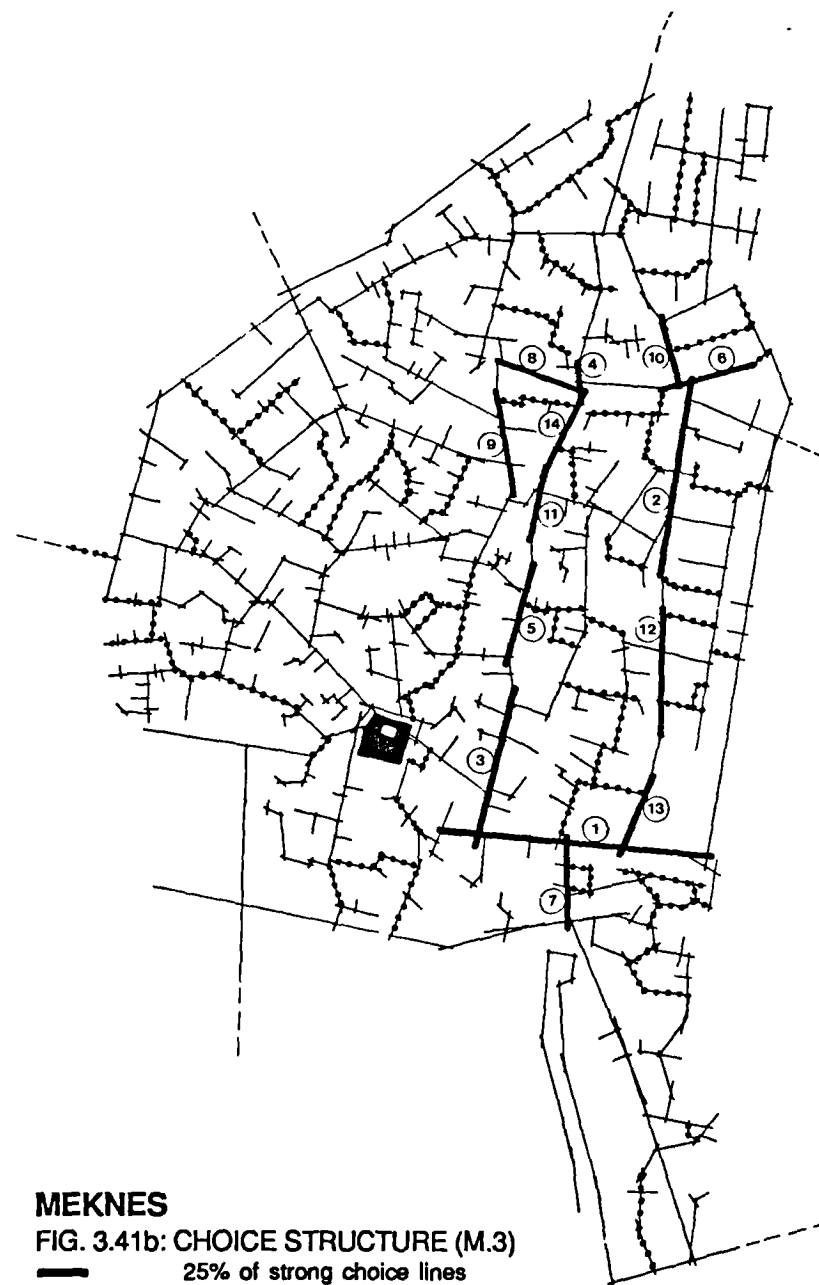
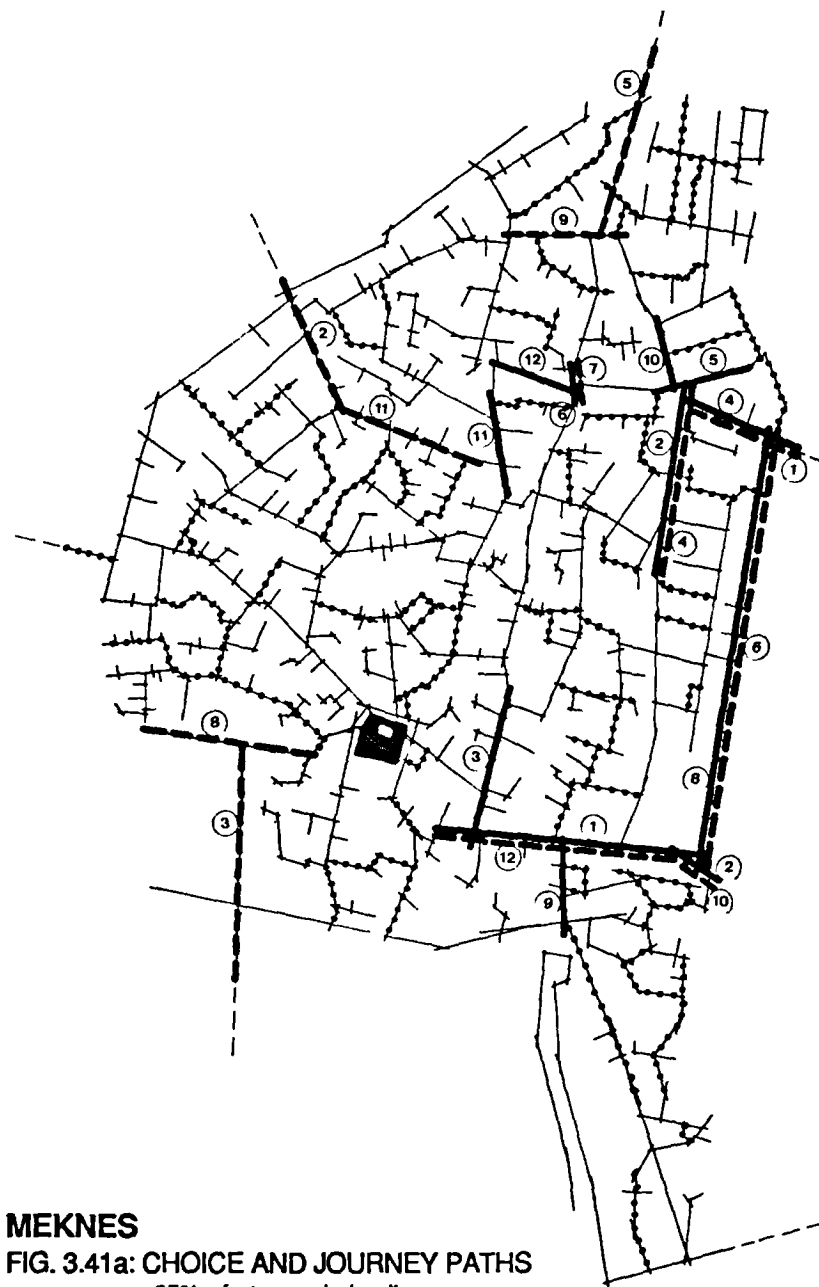
MEKNES

FIG. 3.38: INTEGRATION CORE (M.1)

- 5% of most integrated lines
- 10% of most integrated lines
- ... 50% of most segregated lines



**MEKNES****FIG. 3.40: RADIUS-3 INTEGRATION CORE (10%)**



THE TOWN OF FEZ:

Fez is the largest system in the sample, with a size of 723 axial lines in the distributed system and 1590 in the whole system. The map in Figure 3.42 shows also the most distorted and broken up axial structure, chiefly characterized by short lines joined in a "zig-zag" manner. The axial structure presents hardly any line or set of lines that are dominant in terms of their length; but the lines that link the town gate "Bab Boujeloud" to the inside of the system tend to meet at open angles and form two prevalent axial routes connecting the town centre to the outside. There seems to be no important differentiation in the axial organisation of the two parts of the town located on either side of the river bank. The southern area in proximity of the great mosque of the eastern bank and the southern periphery of the western bank are marked by the location of much larger blocks penetrated by less dead-ends than the other parts of the urban fabric. Despite the large number of gateways to the town, these access points are not particularly axially demarcated. As in Algiers and Tunis, the axial structure of the market of luxury goods known as "kassariyya" is predominantly more regular and is constituted by very short lines defining small islands. The ratio of the total number of axial lines against the number of distributed lines (2.199) is the highest in the whole sample. These non-distributed lines have also the highest mean depth (1.9379) of all systems (see Table 3.1, p. 167), and some dead-ends are over 8 axial steps deep.

SPATIAL PROPERTIES OF THE QUARTERS:

Table 3.14 sets up the first and second order measures of the 13 quarters (*), the two parts on the east and west bank of the river, and the town as a whole. The first result is that the 13 quarters of Fez vary substantially in terms of size from 27 to 169 axial lines. The quarters show also great variation regarding their mean connectivity, the mean of which is below the mean of the whole town or of the two parts taken separately (P.F.1 and P.F.2 in Table 3.14). The maximum connectivity varies also in the different parts of the town and is in most cases far below the maximum of the large system. The quarters differ also in their level of integration which is very low and in most case (except for Q.F.9 and Q.F.13) higher compared to the level of integration of the town as a whole. The mean of the mean integration of the 13 quarters (1.718) remains higher than the one given by the town as a whole or the means given by the two parts. The maximum segregation (max. RRA) on the other hand, is markedly high reaching 3.645 in Q.F.3, compared to 1.5316 for the 75 urban areas.

The table shows also a great variation in the intelligibility ($1:RA/CN$) and movement interface ($1:RA/RCH$) of the 13 quarters. The mean value of the relative intelligibility of the quarters, when compared to the town as a whole or the larger system (PF.2) of the two parts, is very poor. The relative intelligibility is exceptionally low in quarters QF.4, QF.7 and QF.13. The relative movement interface

(*) For the limits of the 13 quarters, the reader is referred to Figure 3.43a. P.F.1 and P.F.2 in the table correspond to the two parts of the town, located on either side of the river, once linked to each other by only few bridges. As such they are not quarters in the sense used earlier.

varies strongly regardless of size; it is low in most of the quarters and remains so in the large system. Only three quarters (QF.1, QF.7 and QF.13) have a movement interface higher than the urban average. The local predictability and the interface potential of the quarters show also a great deal of variation, with the mean value for each measure being higher than in the town as a whole or in the two parts.

Clearly, the above results show a great deal of variation in the structuring of the quarters of Fez, by contrast to Tunis (see Table 3.1, p. 167). That is, the town of Fez, when taken as a whole, increases but not markedly its maximum connectivity, increases substantially its level of segregation and becomes relatively more intelligible than its parts, but it maintains a poor movement interface. How is it be possible that the grid structure of Fez when taken as a whole, becomes more segregated but at the same time improves strongly its relative intelligibility? The most plausible explanation would be that there may be two types of interpretation of intelligibility (when the correlation is strong): one created by the super-grid structure as in Tunis or Sale, the other being perhaps a statistical artefact created by a higher correspondence between the less integrated lines in the whole town and the poorly connected.

The integration cores of the two parts and the 13 quarters of Fez are presented in Figures 3.43a and 3.43b. The examination of the structure of the 15 cores suggests three types:

- a traversing core developing linearly, such as QF.10 and QF.5; or traversing and forming a small cluster in the central part such as QF.13.
- a core clustering in the central part connected on one side to the outside of the quarter or the part, such as Q.F.3, Q.F.6, Q.F.12, Q.F.11, P.F.2 and Q.F.1.
- a core developing on the periphery of the quarter with some penetrating lines, such as Q.F.2, Q.F.8, Q.F.9 and Q.F.4.

Figure 3.43b shows the integration cores of the two large parts (P.F.1 and P.F.2) of the town located on either side of the river.

_ In Q.F.1, the most integrated spaces form a dense cluster in the central part around the main mosque of the quarter, without connecting to the outside (see also fig. 3.42). The second and third best lines in terms of integration intersect at the main mosque; while the most segregated spaces develop along the edges of the quarter.

- In Q.F.2, the most integrated spaces develop linearly along the main commercial street and form a dense cluster in the "suqs" area in proximity of the main mosque of this quarter (see also fig. 3.42). The core is located in the central part of the quarter and does not connect to the outside nor to the periphery. The first and second best integrators lie on the most important commercial street. The most segregated spaces similarly to QF1, develop around the integration core, on the periphery of the large quarter. The most interesting

result is that, in the midst of this apparently disorderly structure, the commercial streets and main mosques in both "halves" emerge as the most integrating elements.

SPATIAL PROPERTIES OF THE WHOLE SYSTEM:

	F.1	F.2	F.3
K	723	1590	-
MEAN CN	2.7746	2.5472	-
MAX. CN	10.00	14.00	-
MEAN RRA	2.2063	1.9772	-
MAX. RRA	3.7390	3.6376	-
MIN. RRA	1.5002	1.2384	-
ST. DEV.	0.3823	0.3717	-
1:RA/CN	0.4600	0.3500	-
REL. INTELL	-.0175	-.0105	-
1:RA/RCH	0.4300	0.3700	-
REL	-.1056	-.0563	-
CN/CH	0.4900	0.5500	-
CV/CH	0.3300	0.3600	-

TABLE 3.15: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF FEZ

Table 3.15 gives the results of the analysis of Fez. These are:

- the mean connectivity is so far, the second lowest after Tangier and decays when the dead-ends are considered (F.2); while the maximum connectivity which is far below the urban average (14.28) is identical

to that of Algiers, Sale, Susa and Tangier. The system of Fez is the most segregated of all (see Table 3.1, p. 167), with a mean integration improving but only weakly when the system is considered with the dead-ends (F.2). The maximum segregation in this town (max. RRA) is exceptionally high (3.739) compared to the 75 urban areas (1.5316) or to any other previous case.

- The town has an almost average level of relative intelligibility (1:RA/CN), approaching the intelligibility of Tunis or Sale. It remains constant in the systems with the dead-end passages (F.2); and similarly to Constantine, the system of Fez shows a very poor level of movement interface. The local predictability and the interface potential of the system are the lowest compared to the towns presented earlier, approaching however, the correlations shown by Constantine (see Table 3.1, p. 167).

Clearly, Fez the largest town of the sample presents the lowest level of integration of all systems analysed in this report. The results point to the conclusion that in Fez, the dead-ends, although strongly segregated with respect to the town as a whole, do not contribute to the high level of segregation of the whole system as already seen in the previous cases. The high level of segregation is clearly created by the highly distorted axial structure of this town and its strongly deformed urban grid. But, the most striking characteristic of this system by contrast to Constantine, is the fact that the town taken as a whole, becomes much more segregated than its parts, but also improves its relative intelligibility. Constantine on the other hand, when taken as a whole, becomes more segregated, less intelligible

and develops a lower movement interface than its parts (see Table 3.1, p. 167).

Figure 3.44 shows the most integrated spaces of the system. The first seven best integrators develop linearly along the market streets which link the bridge to the market area (see also fig. 3.42); and all remaining spaces run also along other market streets. The integration core is densely concentrated in the central part of the town, more on the western bank where the markets and the main mosque are located. The core does not connect to the outside nor to the periphery, but runs across the bridge which relates the two parts of the town. Despite its remoteness, the second main mosque of the town located in the eastern bank, remains fairly integrated with respect to the whole town. This result suggests the existence of a certain duality in the spatial structure of the town as a whole, reflecting its historical growth. The most segregated spaces on the other hand, develop all around the periphery with a denser concentration on the southern part and in the vicinity of the town gates and also with a tendency to form rings.

When the system is analysed with the dead-end passages (F.2), the core shifts more towards the market area of the western bank (see fig. 3.45). The 10 most integrated spaces develop along market streets and the covered market near the great mosque. The main mosque of the eastern bank remains also on the core. However, the overall shape and location of the core is in a large measure, similar to the core of the previous version (F.1). The most segregated spaces remain also similar to F.1.

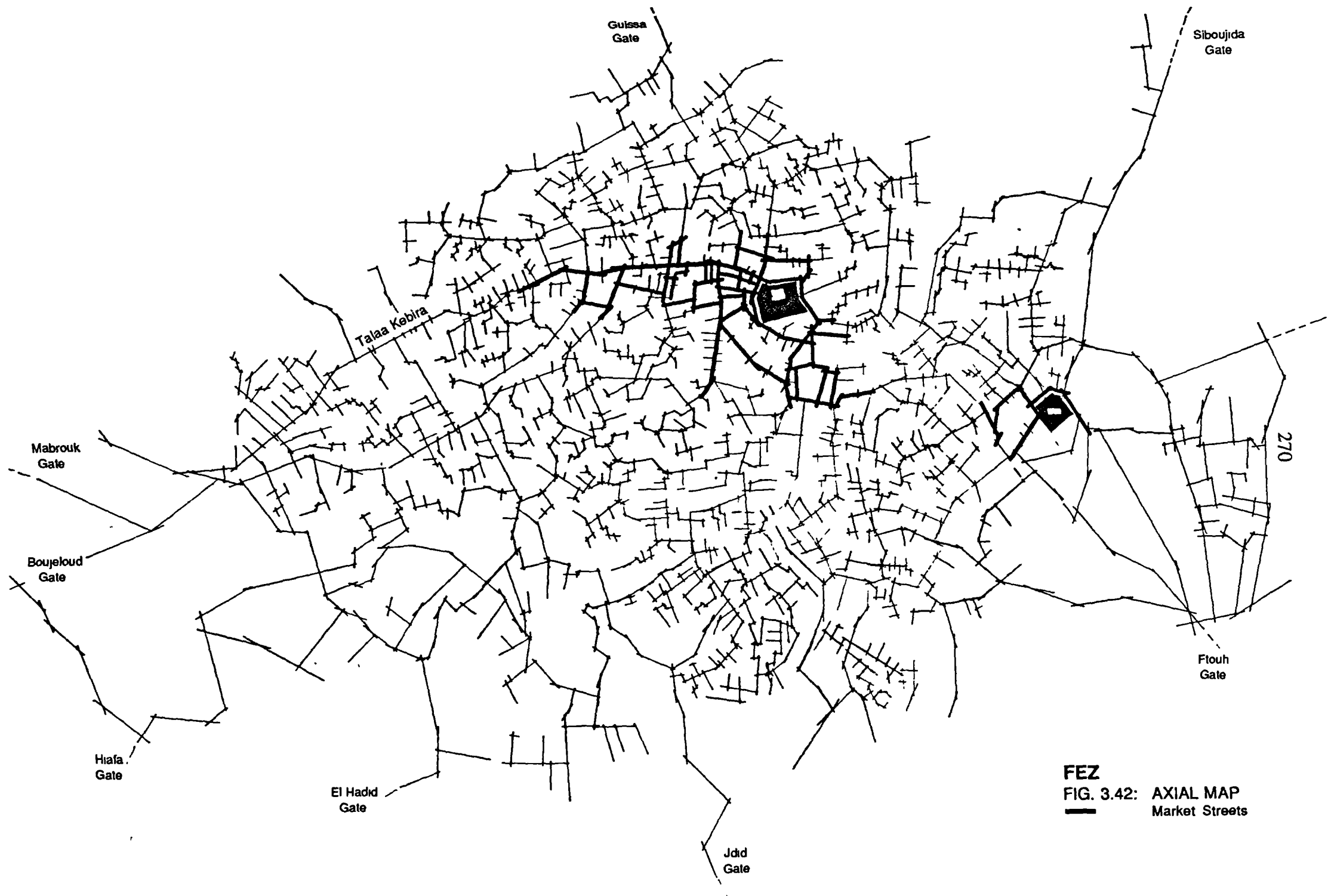
Figure 3.46 shows the radius-3 integration core which forms two dominant cluster, mainly along the market streets and around each of the two main mosques of the town. The structure of radius-3 core expresses the dual spatial organisation of the town centred around the two main mosques, which both have been found to be integrated with respect to the whole town. The overall structure of radius-3 core is, as in Constantine or Meknes, more broken up compared to the structure of radius-n core. However, radius-3 core includes a few lines at the eastern and southern periphery that are segregated at the global level. This suggests then that the town of Fez as it grows, it does not seem to develop more global features that are mainly geared to link "centre to edges". The combined core map shows that the integration cores of the 13 quarters do not tend to interlink (see fig. 3.43a). Radius-3 core does neither strongly overlap with the local cores of the quarters, nor does it link the latter.

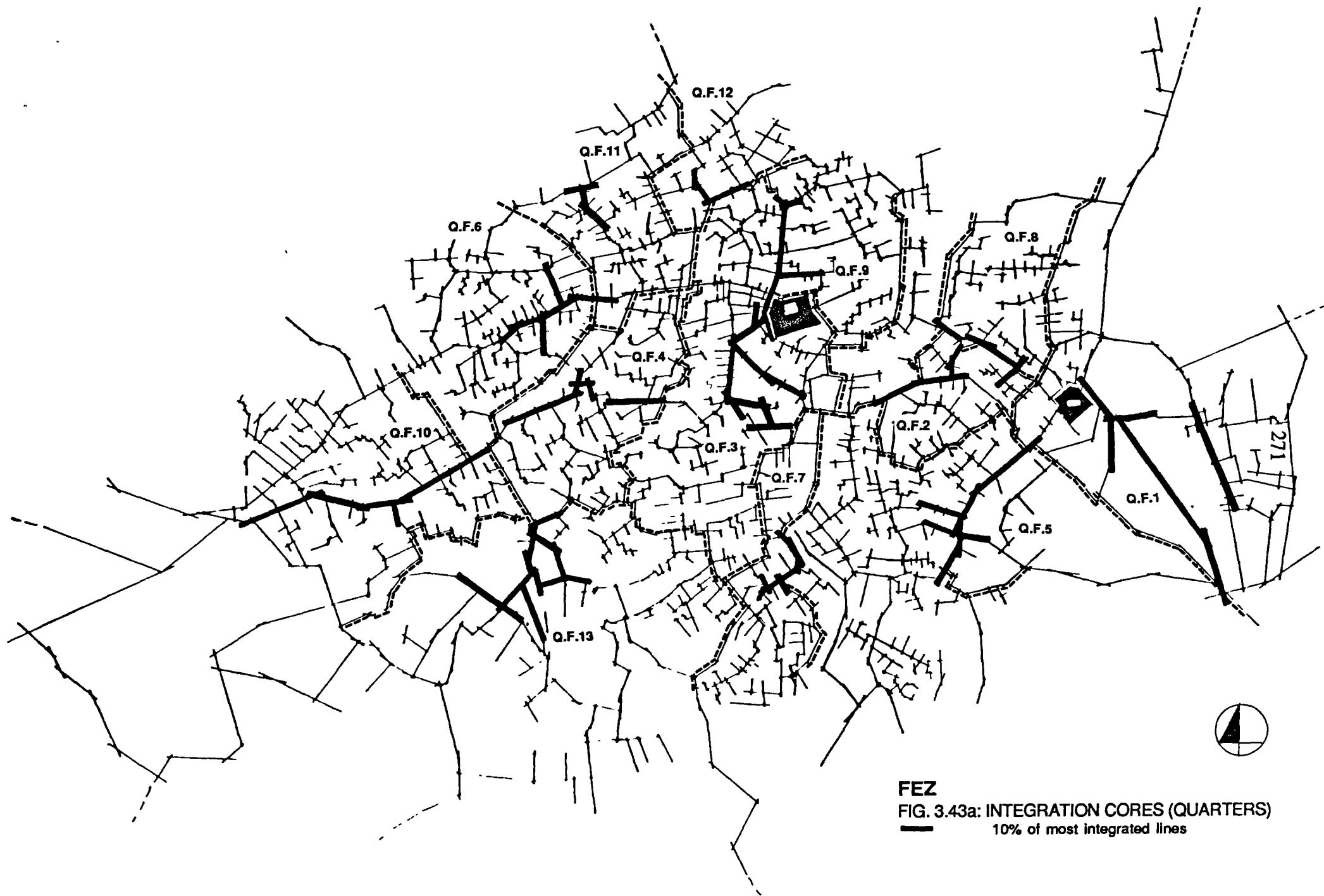
Figure 3.47 shows the strong choice lines (F.1) and the best spaces in the computer-generated random journeys from the outside. The first strong line in terms of choice runs across the market streets, the second and the third intersect at the bridge, while the seventh which is remote from the other lines, lies in the vicinity of the main mosque of the eastern bank. The strong choice lines form one dominant linear structure running across the market street, through the bridge towards a town gate, without connecting to the outside.

There is little overlap between the choice and journey paths, which is clearly expressed by the weak correlation (0.2904) between the two spatial quantities (see the respective scattergram, Appendix 2), indicating therefore, using the spatial evidence alone, a poor

interface between the theoretical paths of the inhabitants given by the choice and the paths of the strangers given by the random journeys from the outside.

The maze-like grid structure of Fez is clearly demonstrated by the analytical measures which have shown extreme properties, such as the lowest level of integration for the largest system of the sample. This highly deformed grid displayed an "isolated" global structure as it presents an internal and centralized core that does not connect to the outside, nor to the periphery. But, the most amazing result is the strong relationship between the overall structure of the grid and the key public facilities. Within this maze-like structure, it is the main market streets and the two main mosques which emerge as the most integrated elements from all parts of the grid.

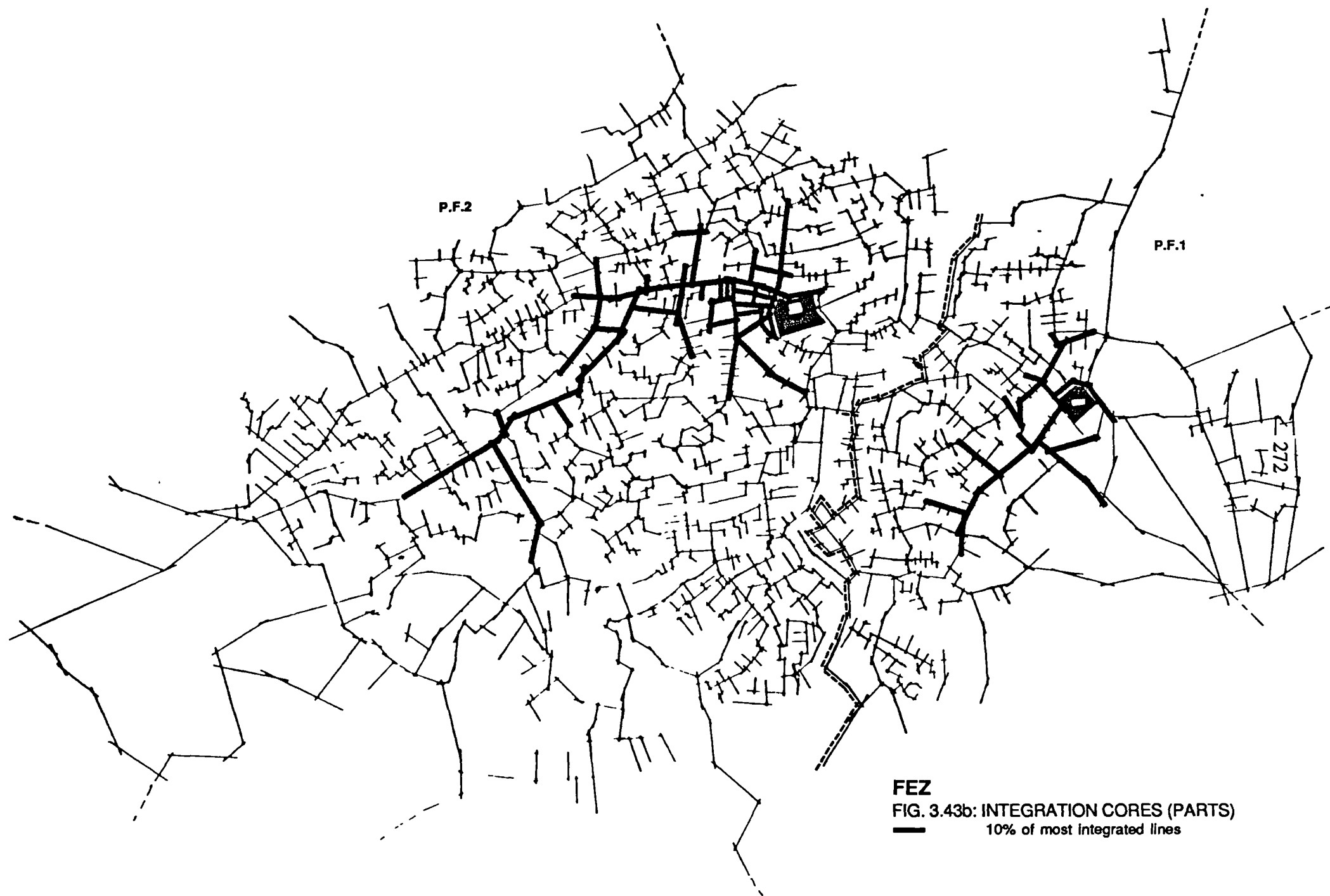




FEZ

FIG. 3.43a: INTEGRATION CORES (QUARTERS)

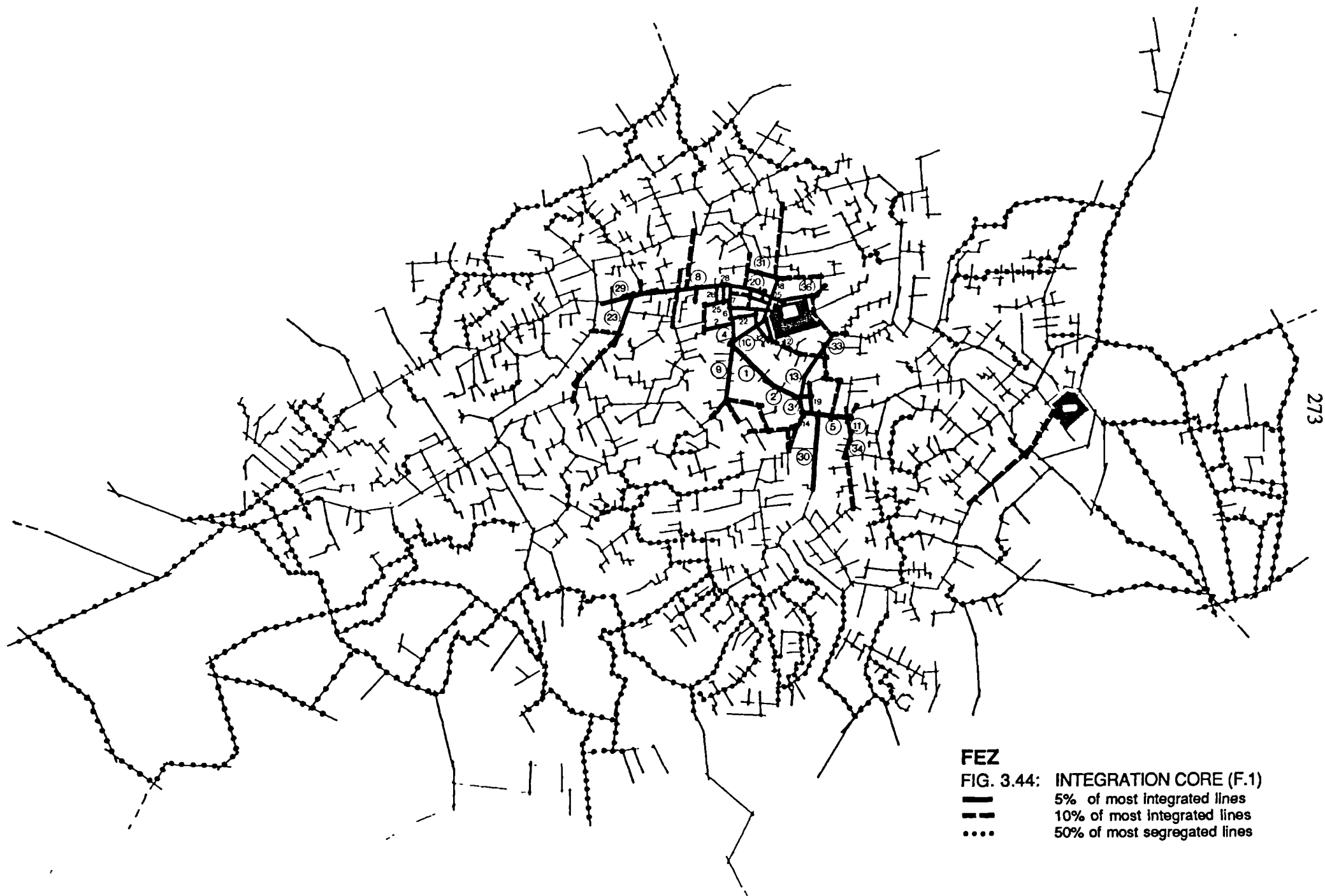
— 10% of most integrated lines

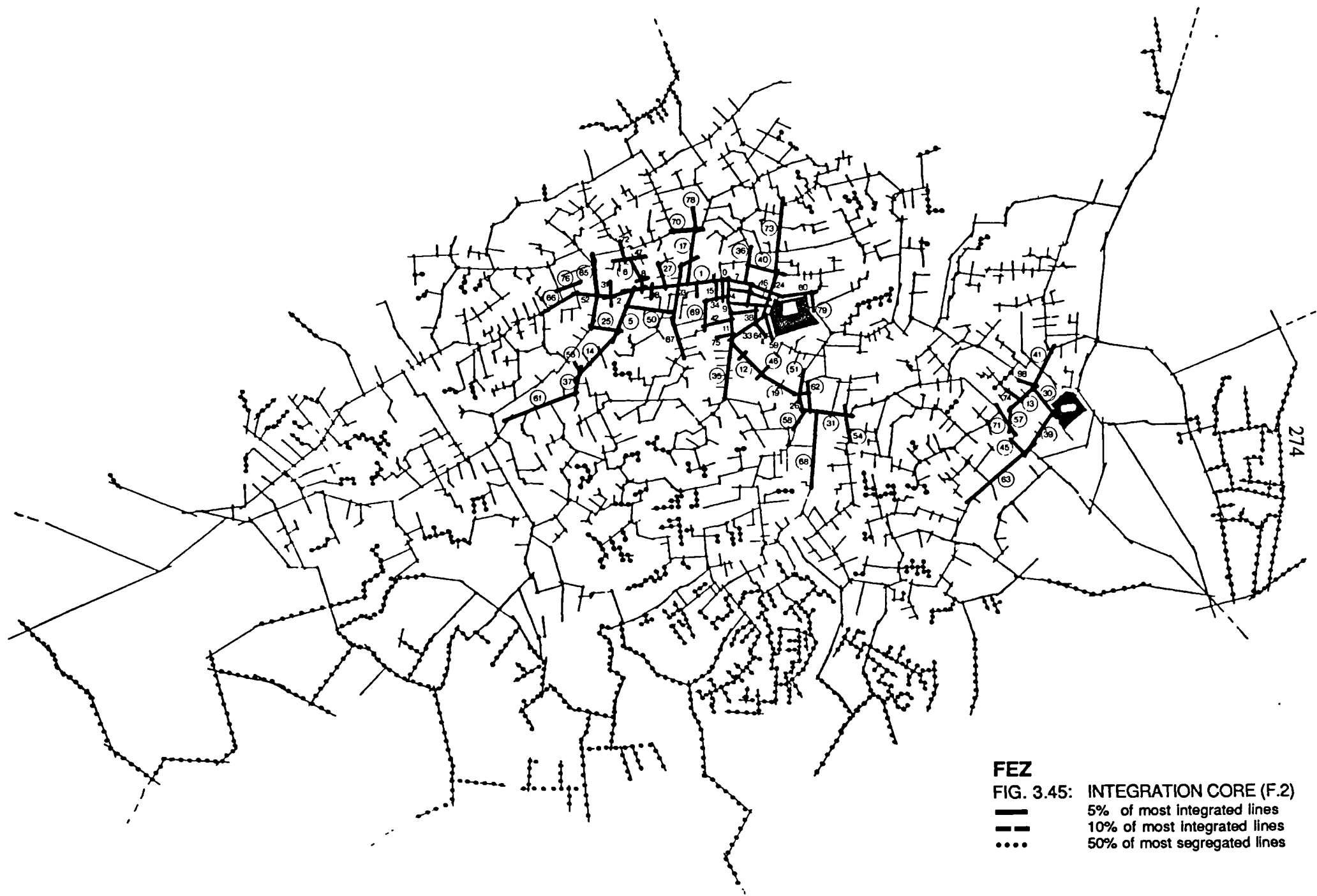


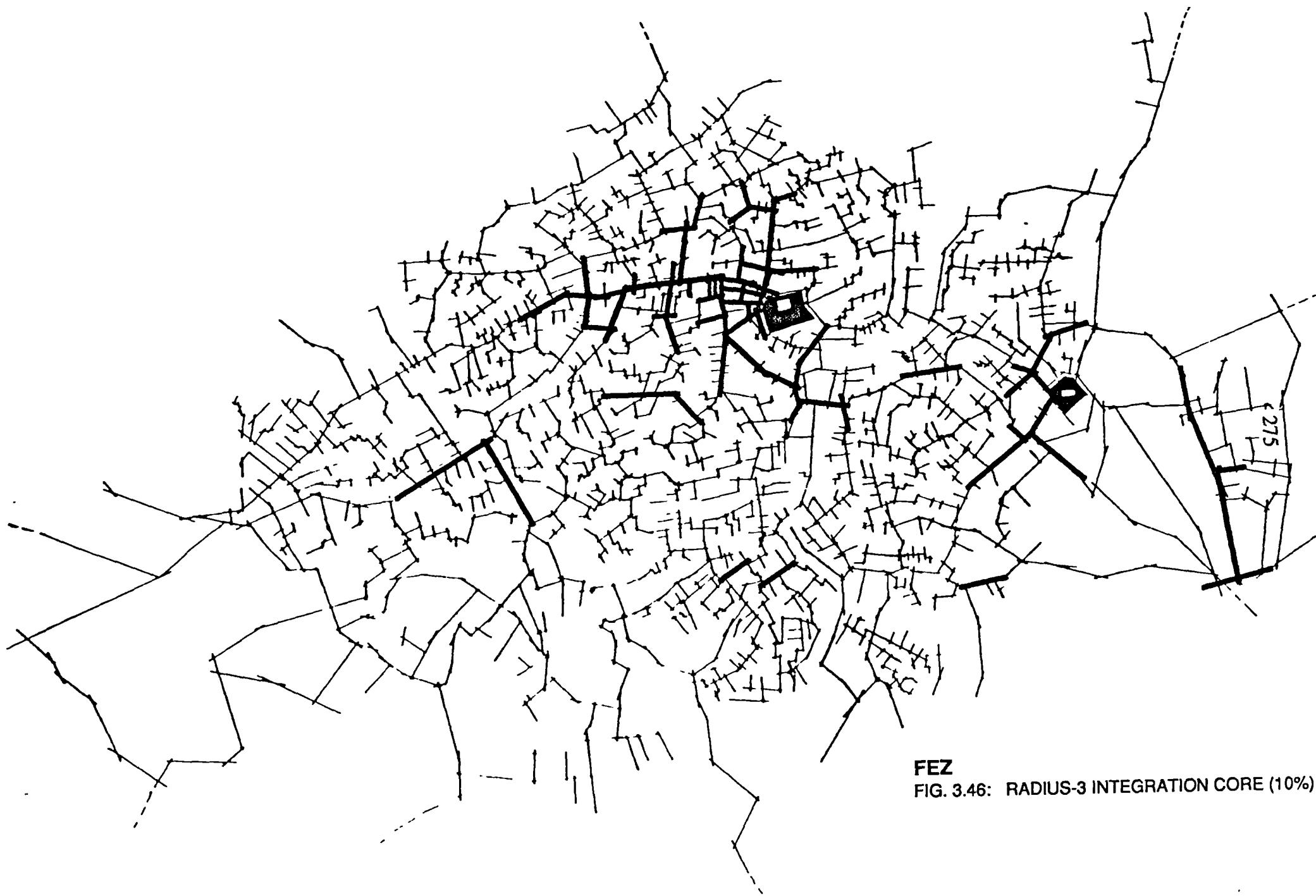
FEZ

FIG. 3.43b: INTEGRATION CORES (PARTS)

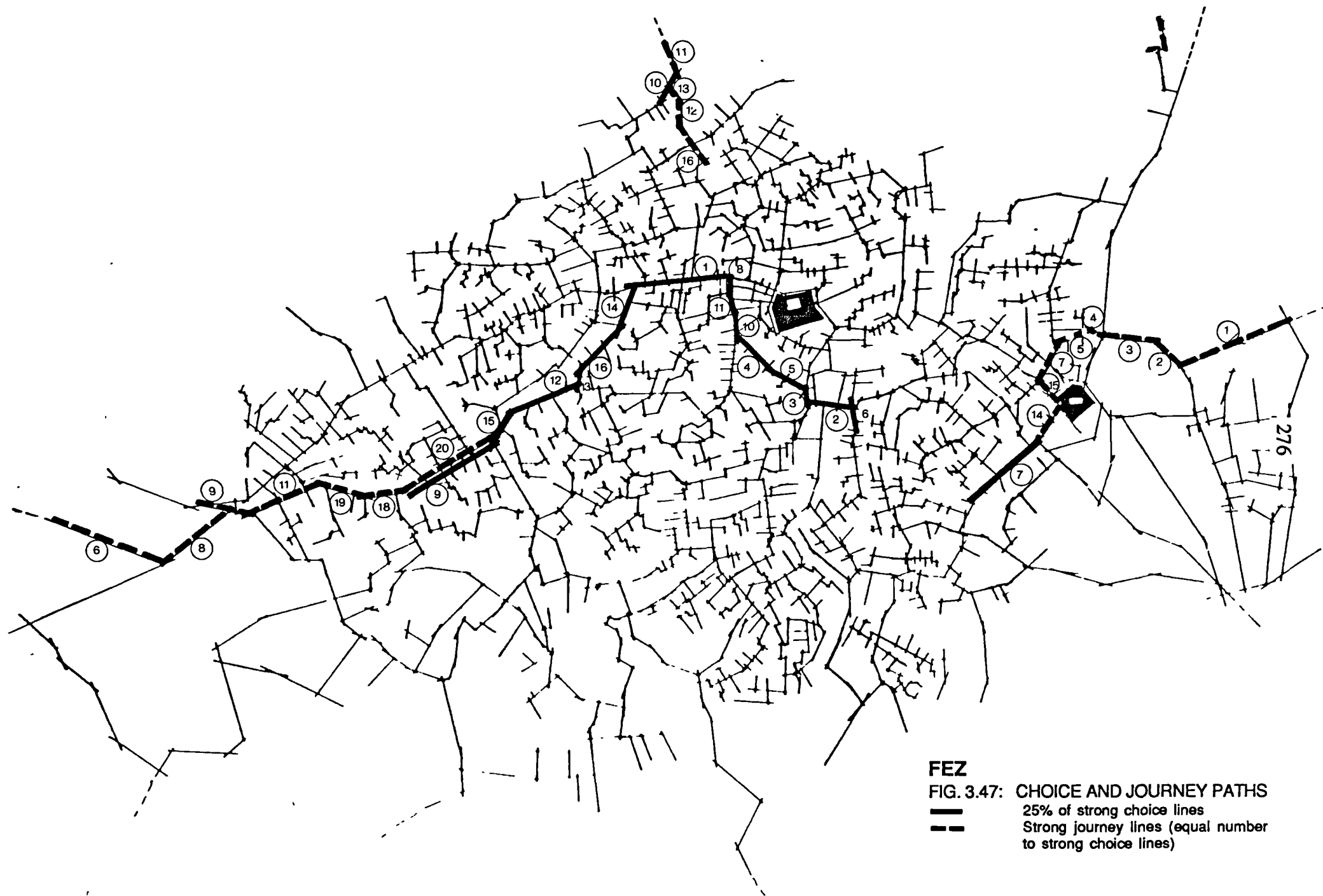
— 10% of most integrated lines







FEZ
FIG. 3.46: RADIUS-3 INTEGRATION CORE (10%)



THE TOWN OF KAIRWAN:

The axial structure of Kairwan has the third highest ratio of the total number of axial lines (including the non-distributed lines) against the number of distributed lines ($K2/K1 = 1.815$); the mean depth (1.589) of these is about the same as in Tunis and Algiers. A prevalent feature of this axial organisation is the location of the longest lines in the vicinity of the great mosque at the northern periphery of the town (see fig. 3.48). As seen in several other towns (Tunis, Algiers and Fez), the main market area is predominantly constituted by very short lines meeting at more regular angles. The lines linking the two gateways through the market area intersect at very wide angles, forming an almost straight route across the system.

	K.1	K.2	K.3
K	271	492	243
MEAN CN	3.1070	2.7927	2.9630
MAX CN	8.00	10.00	7.00
MEAN RRA	1.3355	1.3120	1.5812
MAX. RRA	1.9952	2.2900	2.3400
MIN. RRA	0.9849	0.9100	1.0700
ST. DEV.	0.1829	0.2085	0.3062
1:RA/CN	0.5100	0.5200	0.4100
REL.INTELL.	-.0816	-.0052	-.1930
1:RA/RCH	0.7100	0.6200	0.6100
REL	+.0636	+.0384	-.0474
CN/CH	0.5900	0.6400	0.5800
CV/CH	0.4300	0.4100	0.3500

TABLE 3.16: FIRST AND SECOND ORDER MEASURES
OF THE TOWN OF KAIRWAN

Table 3.16 gives the measures of Kairwan and indicates that the mean connectivity of the system is fairly close to that of Algiers or Susa. The maximum connectivity as in Constantine is so far the lowest of all towns, and does not decrease substantially when the peripheral streets are discounted (K.3). The results indicate that Kairwan has a level of integration approaching Tunis or Susa, with a clear loss of integration when the system is considered without the peripheral streets, suggesting then that the integration of the system is dependent to some extent on the connections of the town grid to the periphery as observed in Susa (see General Data Table 3.1, p. 167).

The town grid exhibits a low relative intelligibility (1:RA/CN) compared to for instance Susa, which improves considerably when the town is looked at with the dead-end passages (K.2), but also decays considerably in the system looked at without the peripheral streets (K.3). The town of Kairwan shows a similar level of relative movement interface (1:RA/RCH) as Tunis or Algiers, but a higher measure when compared to Susa.

The integration map in Figure 3.49 shows that the first integrator lies at the junction of the main market streets where the sacred well is located; the second and the fourth lines run also along the market streets and connect to the outside; while the third strongest line runs adjacent to the citadel, and from which develops the other penetrating "route" in the direction of the sole central large square where the cloth-making market is located. The main integrating lines are remarkably in the market area and form a continuous structure developing along the periphery, penetrating the town on two points

without however, traversing it. The core connects strongly the market streets to the citadel and to the mosque, which are located far away from each other. The most segregated spaces mainly develop around the edges and form the largest clusters on the south and north-eastern corners of the town.

When the dead-ends are considered in the analysis of the system (K.2), the core remains on the periphery with more penetrating lines, directly connecting the main market street to the outside, the citadel and the mosque (see fig. 3.50a). The first integrator and the fourth remain on the main market street and strongly connect to the outside. The most segregated spaces include most of the dead-ends (73% of the total number of the dead-end spaces). In this case, the town does not present a segregated cluster in the north-eastern corner as previously (K.1).

Figure 3.50b shows the integration core of the system analysed with the peripheral lines removed (K.3), which as a result, the core becomes clustered in the central part of the town, around some market streets (cloth-making market), and forms a dominant "route" pointing in the direction of a town's gate. The first and second integrators running along the market streets of a lesser importance, now intersect at the large central open square. The main commercial street and main market area are no longer integrating as in K.1 and K.2, leading to the conclusion that their integration is strongly related with the connection of the town to the periphery. In this case, the great mosque becomes highly segregated, also suggesting that the strong accessibility of the mosque with respect to the town

as a whole and its connections to the market area is achieved only through the peripheral streets. The change in the structure of the integration core following the removal of the peripheral streets is unique to the town of Kairwan, especially when compared to Susa where a marked loss in the level of integration has been also observed, but without affecting the structure of the core.

Radius-3 core in Figure 3.51 forms three clusters, one on the main market street, the 2nd also developing along the market streets adjoining the large central square and the 3rd and the largest cluster extends essentially at the periphery forming a ring around the great mosque. The structure of radius-3 core suggests then that the mosque, the market area and the large open square appear also to be important magnets in the local structure of the town, but also corroborates the idea of a multi-nucleus structure in this town.

The choice path in K.1 (see fig. 3.52a) presents a continuous structure linking strongly the main market street to the great mosque through the periphery. The two strongest choice lines run along the periphery, while the third and the fourth lie on the main market street. The journey path also develops in the market area and near the great mosque, without however being continuous. The main market street and the streets adjoining the mosque emerge as the best spaces in the random journeys from the outside. The map shows a correspondence of the choice and journey structure, although to a varying degree in terms of order. The correlation of 0.6376 (see Scattergram in Appendix 2) expresses a relatively high interface between the theoretical paths of the inhabitants given by the choice measure and

the paths of strangers given by the spatial measure of random journeys from the outside.

When the peripheral streets are omitted in the analysis of the system (K.3), the choice structure is not any more continuous, and unlike the integration core for this version it includes the main market streets but not the great mosque (see fig. 3.52b). The best lines of the journeys' path do not present major difference from the previous case (K.1) and the map shows an overlap of the two quantities in the market area only. From this, it appears that the great mosque remains on the journey path whether the system is looked at with or without the peripheral streets. The results suggest then that the interface between the paths of the inhabitants and strangers as described theoretically, using the spatial evidence alone, is likely to take place in the market streets and in the area of the great mosque.

The main distinctive features in the spatial structure of Kairwan are the strong dependence on the linkages of the system to the periphery for its integration; and the three-level organisation in the overall structure of the grid, centred around the great mosque, the public square and the main market streets, clearly exhibited by the structure of radius-3 core.

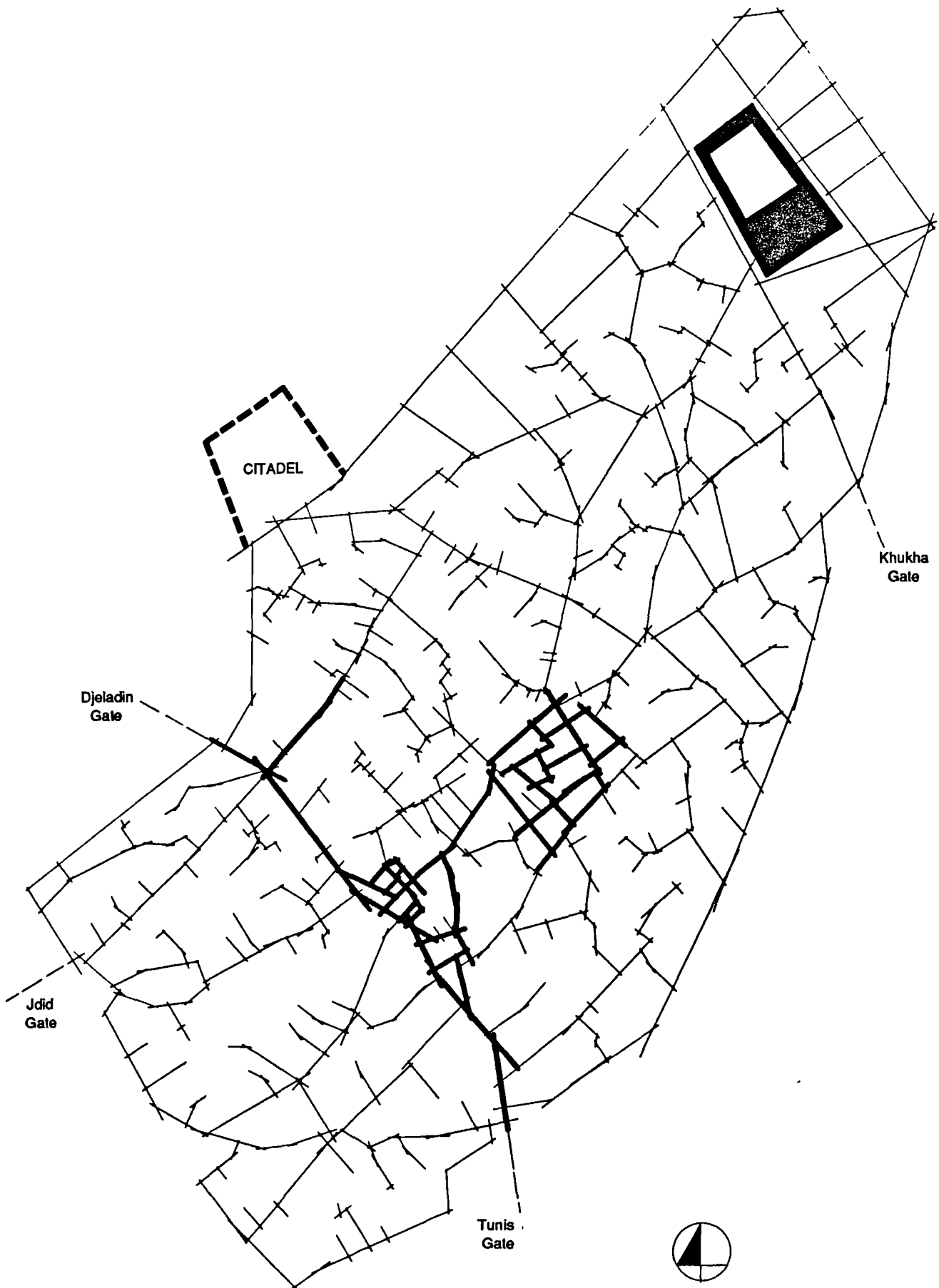
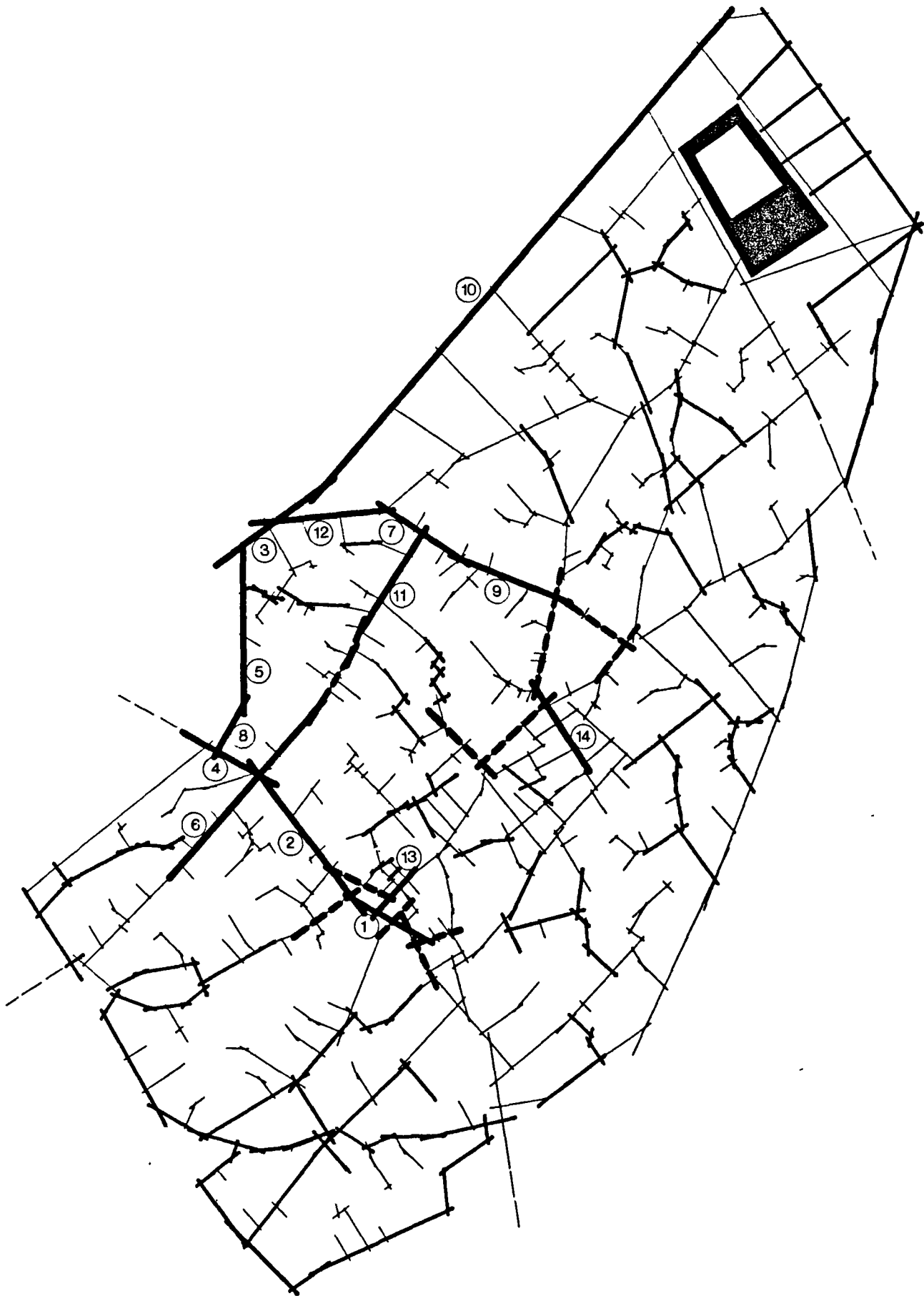
**KAIRWAN**

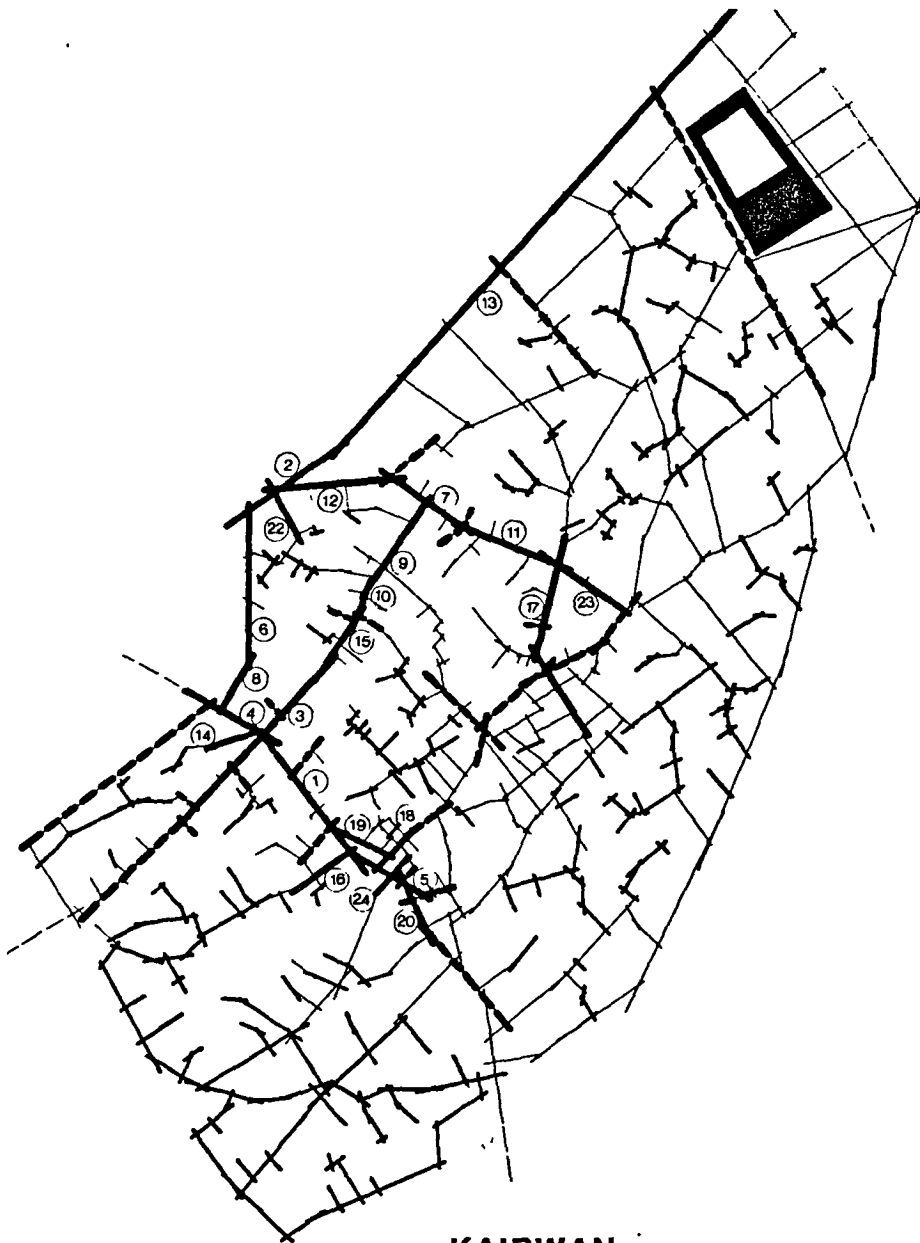
FIG. 3.48: AXIAL MAP
— Market Streets



KAIRWAN




FIG. 3.49: INTEGRATION CORE (K.1)

- 5% of most integrated lines
- ==** 10% of most integrated lines
- 50% of most segregated lines



KAIRWAN




FIG. 3.50a: INTEGRATION CORE (K.2)

-  5% of most integrated lines
-  10% of most integrated lines
-  50% of most segregated lines



KAIRWAN

FIG. 3.50b: INTEGRATION CORE (K.3)

-  5% of most integrated lines
-  10% of most integrated lines
-  50% of most segregated lines

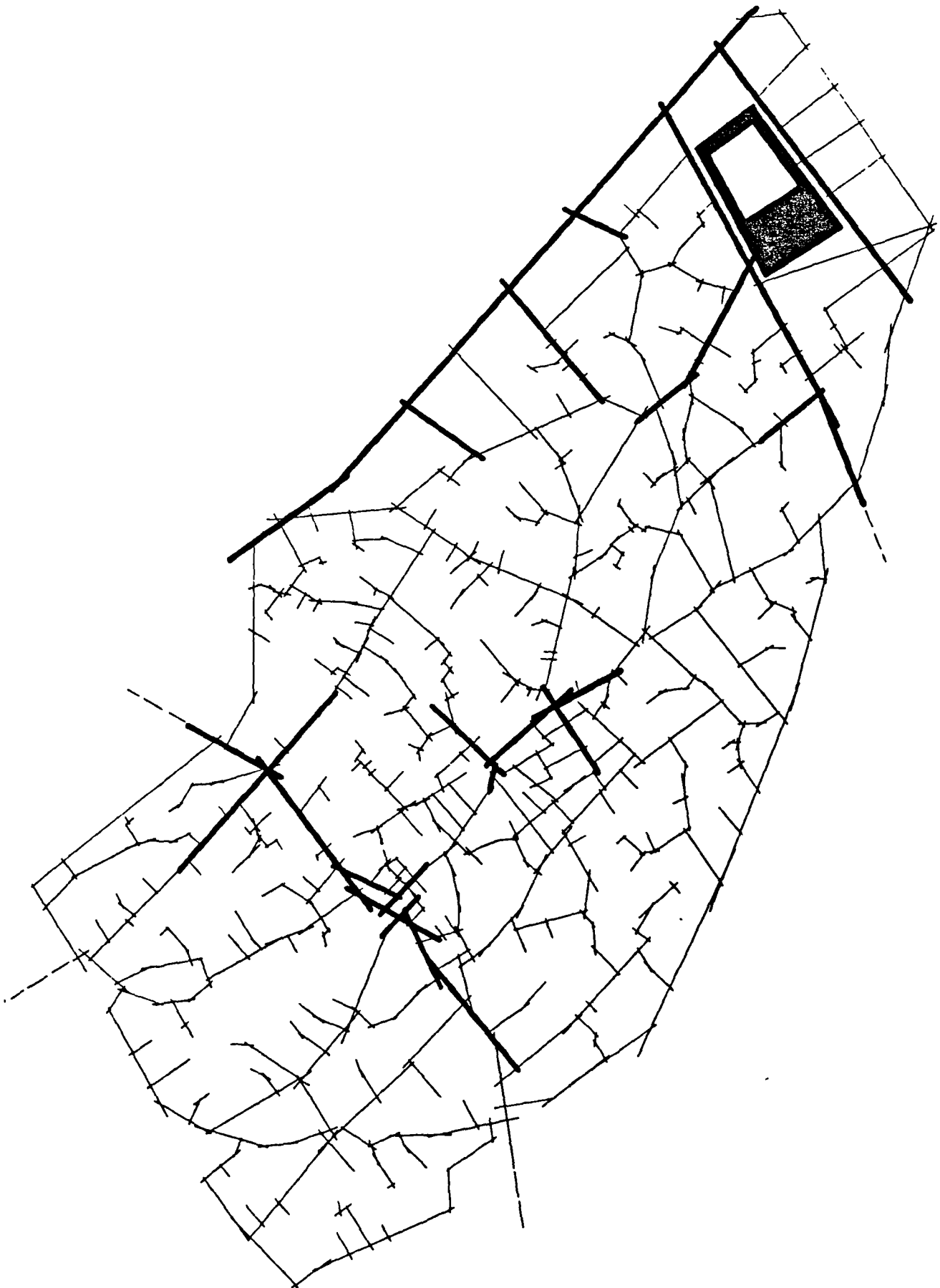
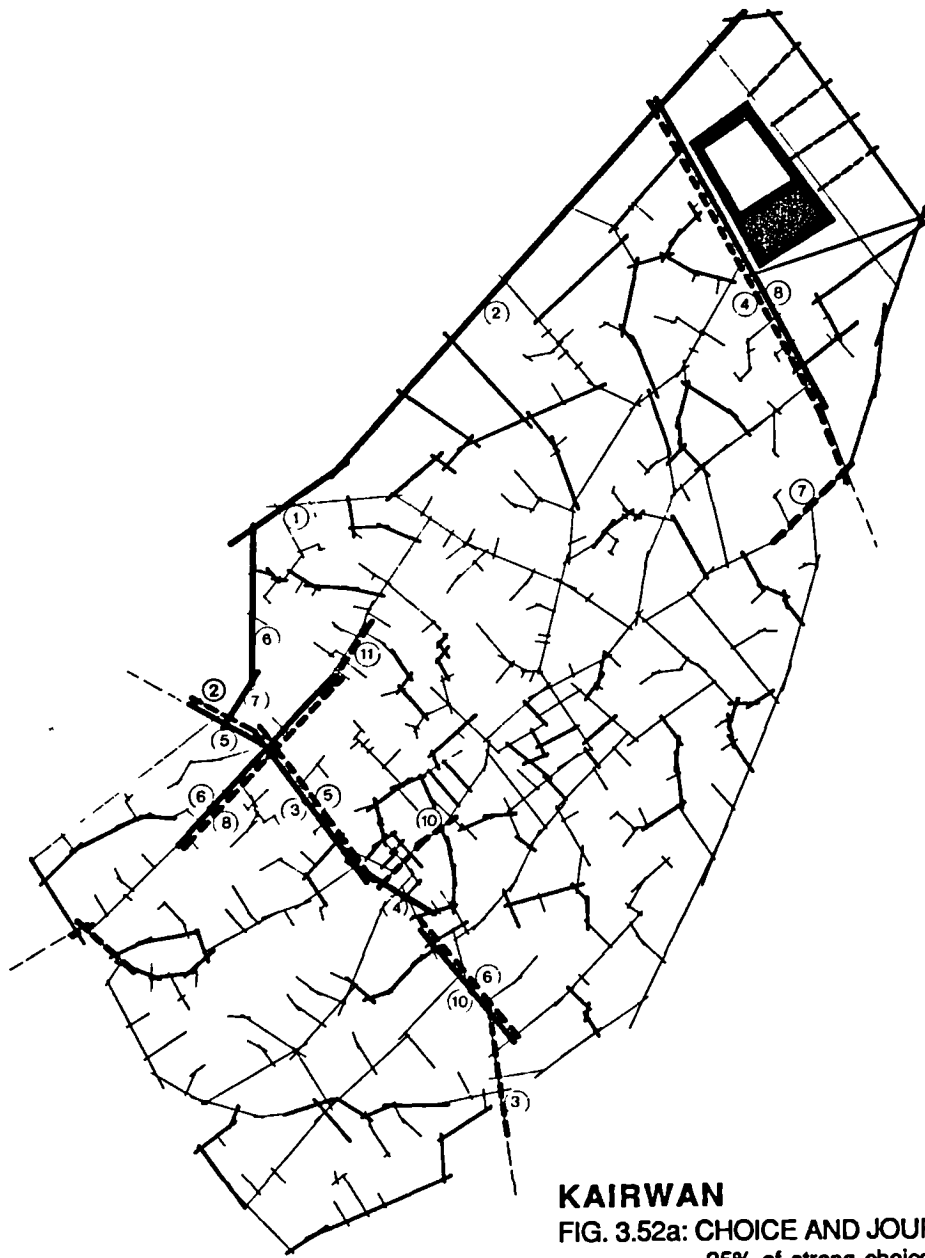
**KAIRWAN**

FIG. 3.51: RADIUS-3 INTEGRATION CORE (10%)



KAIRWAN
FIG. 3.52a: CHOICE AND JOURNEY PATHS
 — 25% of strong choice lines
 - - Strong journey lines (equal number to strong choice lines)



KAIRWAN
FIG. 3.52b: CHOICE STRUCTURE (K.3)
 — 25% of strong choice lines

THE TOWN OF WARGLA:

The axial map in Figure 3.53 is constituted by 437 lines, 256 of which represent the distributed system. The ratio of the distributed lines and the total number of axial lines is among the highest (1.707), especially when compared to the ratio in Tunis or Susa. The depth of the non-distributed lines varies between 1 and 4, but the average depth (1.3149) is relatively low compared to that of Fez, Tangier or Meknes. Several long lines delimit the town edges, and others run in the middle of the town across the large open square. Many other lines of relatively similar length tend to intersect at open angles and form a dominant route, east of the market square. The axial organisation of the quarter "Beni-Brahim" appears quite distinctive, especially the "radial-like" structure and the many short lines delimiting long and narrow islands which define the outside boundary of this quarter (see Axial Map in fig. 3.53).

THE SPATIAL PROPERTIES OF THE QUARTERS:

	W.1 (whole town)	Q.W.1 (Brahim)	Q.W.2 (Sissin)	Q.W.3 (Waggin)	MEAN Quarters
K	256	130	87	65	94
MEAN CN	3.242	2.815	3.126	2.892	2.944
MAX. CN	12.00	8.00	7.00	8.00	7.666
MEAN RRA	1.149	1.205	1.040	1.102	1.115
MAX. RRA	1.681	1.692	1.381	1.658	1.577
MIN. RRA	0.696	0.800	0.727	0.638	0.721
ST. DEV.	0.211	0.205	0.140	0.236	-
1:RA/CN	0.580	0.600	0.470	0.650	0.573
RELINTELL	-.017	-.064	-.230	-.076	-.123
1:RA/RCH	0.620	0.780	0.790	0.850	0.806
REL	-.032	+.0618	+.0355	+.0701	+.056
CN/CH	0.690	0.760	0.700	0.720	0.726
CV/CH	0.560	0.590	0.600	0.590	0.593

TABLE 3.17: FIRST AND SECOND ORDER MEASURES OF THE QUARTERS OF THE TOWN OF WARGLA

Table 3.17 gives the spatial measures of the three quarters taken separately and the town as a whole (W.1). It shows that there is a considerable variation of size between the three quarters (i.e. Beni Brahim is twice the size of Beni Waggin). But, the mean of the mean connectivity of the 3 quarters is lower than the one shown by the whole. The maximum connectivity remains also about the same in the 3 quarters, but increases substantially in the large system (from a mean of 7.666 to 12). The mean integration of the quarters varies but

only slightly with respect to each other, but the mean of the mean remains of the same order as in the whole, as is the case of the town of Sale, but not Constantine, Meknes or Fez. On the other hand, the maximum segregation (max. RRA), with the exception of "Beni Sissin" quarter (Q.W.2), is maintained constant in the two other quarters and in the whole.

The quarters present a lower relative intelligibility ($1:RA/CN$) than the whole town; the quarter of "Sissin" has an exceptionally low intelligibility. But, the parts show a little higher relative movement interface compared to the town as a whole. On the other hand, the mean of local predictability of the three quarters approaches the measure of the whole town, decreasing slightly when the town is taken as a whole, and the interface potential remains about the same for the quarters and the whole system.

The system of Wargla when taken as a whole, increases considerably its maximum connectivity, maintains the same level of integration and becomes more intelligible than its parts. This is an indication of the development of some properties of a "super-grid" structure as the town becomes larger, a characteristic already observed in Tunis and Sale.

The integration cores of the quarters of Wargla are shown in Figure 3.54.

- In Beni Brahim (Q.W.1), the first three best integrators intersect at the old market square, while the fourth links this latter to the present market place where the two main mosques are located. The

integration core presents a ring running partly on the periphery, around the site of the old market square, and with lines running in several directions inside the quarter (see fig. 3.54). The core connects to the outside and to the two neighbouring quarters.

- In Beni Sissin (Q.W.2), the two best integrators form an almost traversing linear structure connecting the market square to the vicinity of the gate "Bab Hamid"; while the third best line develops along the shopping arcade. The integration core is constituted by lines running in the central part of the quarter which are strongly connected to the periphery but not to the outside (see fig. 3.54).

- In Beni Waggin (Q.W.3), the most integrated spaces form a traversing core which develops in the middle of the quarter and strongly links to the outside. The core in this quarter runs away from the main mosque and the market place (see fig. 3.54).

The combination of the cores of the quarters reveals a striking feature; that is, the local cores tend to join to form a global structure which tends to extend over the entire fabric in a pattern which approaches the covering-core type as defined in the SERC report; that is, a core with some central spaces linking to the outside of the system in several directions. So far, only Sale and Tunis presented similar characteristic in the structure of the local cores, but to a lesser degree than is the case in Wargla.

THE SPATIAL STRUCTURE OF THE TOWN AS A WHOLE:

	W.1	W.2	W.3
K	256	437	239
MEAN CN	3.2422	2.8650	3.1381
MAX. CN	12.00	13.00	12.00
MEAN RRA	1.1499	1.1276	1.2511
MAX. RRA	1.6810	1.8100	2.0200
MIN. RRA	0.7000	0.6700	0.7000
ST.DEV.	0.2111	0.2055	0.2857
1:RA/CN	0.5800	0.5500	0.5800
REL.INTELL.	-.0176	+.0108	-.0247
1:RA/RCH	0.6200	0.6300	0.5900
REL	-.0321	+.0350	-.0691
CN/CH	0.6900	0.7200	0.6800
CV/CH	0.5600	0.5000	0.4900

TABLE 3.18: FIRST AND SECOND ORDER MEASURES OF WARGLA

The results of the various analyses of the system of Wargla are set up in Table 3.18. These indicate about a mean connectivity which approaches the mean connectivity of Tunis or Sale (see Table 3.1, p. 167). The maximum connectivity is the highest of all towns presented earlier, and remains about the same when the dead-ends are added (W.2) or when the peripheral streets are discounted (W.3). On the other hand, the mean integration in W.1 and W.2 is the highest than in any previous case, although it is close to the mean integration of Sale. Unlike Kairwan, the mean integration decreases but not strongly (from 1.1499 to 1.2511) when the peripheral streets are not taken into consideration (W.3).

The relative intelligibility (1:RA/CN) of Wargla (W.1) is about the

same as in Sale or Tunis, but identical to the relative intelligibility of Fez; it remains about the same when the system is considered with the dead-ends (W.2) and when the system is considered without the peripheral streets (W.3). However, the system shows a much lower relative movement interface ($1:RA/RCH$) compared to Tunis or Sale, which increases in W.2 (system with dead-ends). The system of Wargla presents the second highest local predictability (CN/CH) and also the highest interface potential compared to the previous towns (see Table 3.1, p. 167).

Figure 3.55 shows the 10% most integrated lines which form the core of Wargla (W.1). The most integrated line links the original market to the present market square where the two main mosques are located; the second best integrator which runs along a shopping street, intersects with the first at the market square and strongly links this latter to the old site of the citadel. The third and the fourth best integrators remain also in the market square; while the fifth, the sixth and the eighth develop in the vicinity of the original market place. The integration core forms a linear tree structure in the middle of the town that does not connect to the outside (*). The core runs across the market square and strongly links the main town facilities. The linear development of the integration core of Wargla with the central semi-grid it forms around the market area and mosques, resembles strongly the core structure of Tunis. The most segregated spaces form three main peripheral clusters around the integration core and in each of the three quarters. In the system

(*) When the walls surrounding the old market are disregarded as was the case in the past, the integration core becomes then connected to the outside.

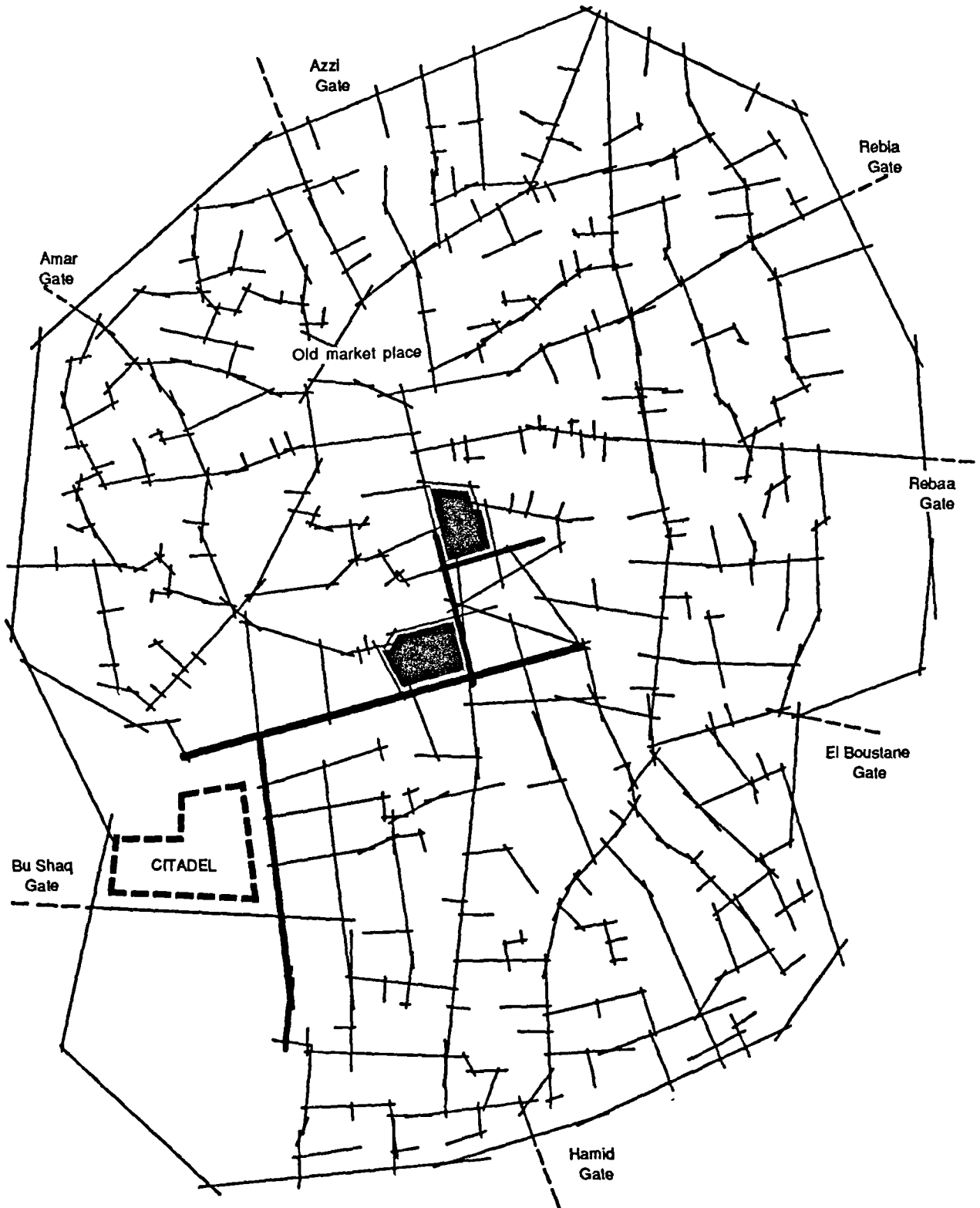
considered with the dead-ends (W2), the integration core remains in the central part of the town. The four strongest integrators intersect at the market square as in the previous case (see fig. 3.56a). The 5th and the 6th best lines remain also in the vicinity of the old market square as in W1. The most segregated spaces maintain their peripheral location and include 70.16% of the total number of dead-ends. When the peripheral streets are omitted (W.3), the core resembles strongly the core of W.1 in terms of overall shape, location and order of integration of the lines (see fig. 3.56b). The first four strong integrators remain the same as in W.1.

Figure 3.57 shows radius-3 integration core which presents strong similarities to radius-n core (W.1), with the market emerging also as a strong local integrator. On the other hand, the combined core (see fig. 3.54) constituted by the cores of the three quarters, includes many lines of both radius-3 and radius-n cores. The structure of the combined core suggests a more covering local structure which appears to be strongly biased against the run of the more confined tree-like global core. In other words, this more covering structure defining the local parts and suggested earlier from the analysis of the numerical properties of the grid of Wargla, appears to be geared towards the local level of organisation, that is relating the quarters to each other and to the global structure of the town. In the light of this, the local movements of the inhabitants might be seen to form a global pattern which tends to cover the entire town grid; while the movements of the strangers given by the structure of the global core might be seen to be confined to the central "zone" of the grid. The only interface between the local and global structures, appears then to take place at the market place and adjoining market streets. This

interpretation remains theoretical and therefore can only be speculative, and more research is necessary to substantiate these claims.

The strong choice lines (W.1) in Figure 3.58a form two routes: one running along the periphery and the other in the middle of the town linking the main town facilities to each other. The first, second and third strong choice lines intersect at the market square. But, the best lines of the journeys path do not overlap strongly with the choice structure. The only two common lines correspond to the shopping streets and the market square. The poor correlation (0.4174) between the choice and journey quantities (see scattergram in Appendix 2) illustrates the weak interface of the two measures. When the peripheral streets are disregarded, the best lines in terms of choice are not very different from the previous case (W.1). These results do not seem to contradict the conclusion drawn earlier about the possible interface that is likely to take place between the inhabitants and strangers at the market square of the town.

Therefore, the most prominent feature of the grid structure of Wargla is the way in which the local cores of the three parts tend to form a connected global pattern which tends to cover the entire fabric, as opposed to the linear tree structure of the global core which is more confined to the central part of the system where the main public facilities are located. It is suggested that it is this particular property which contributes in maintaining the same level of integration of the whole town as its parts and improves the intelligibility of the whole town with respect to its parts.

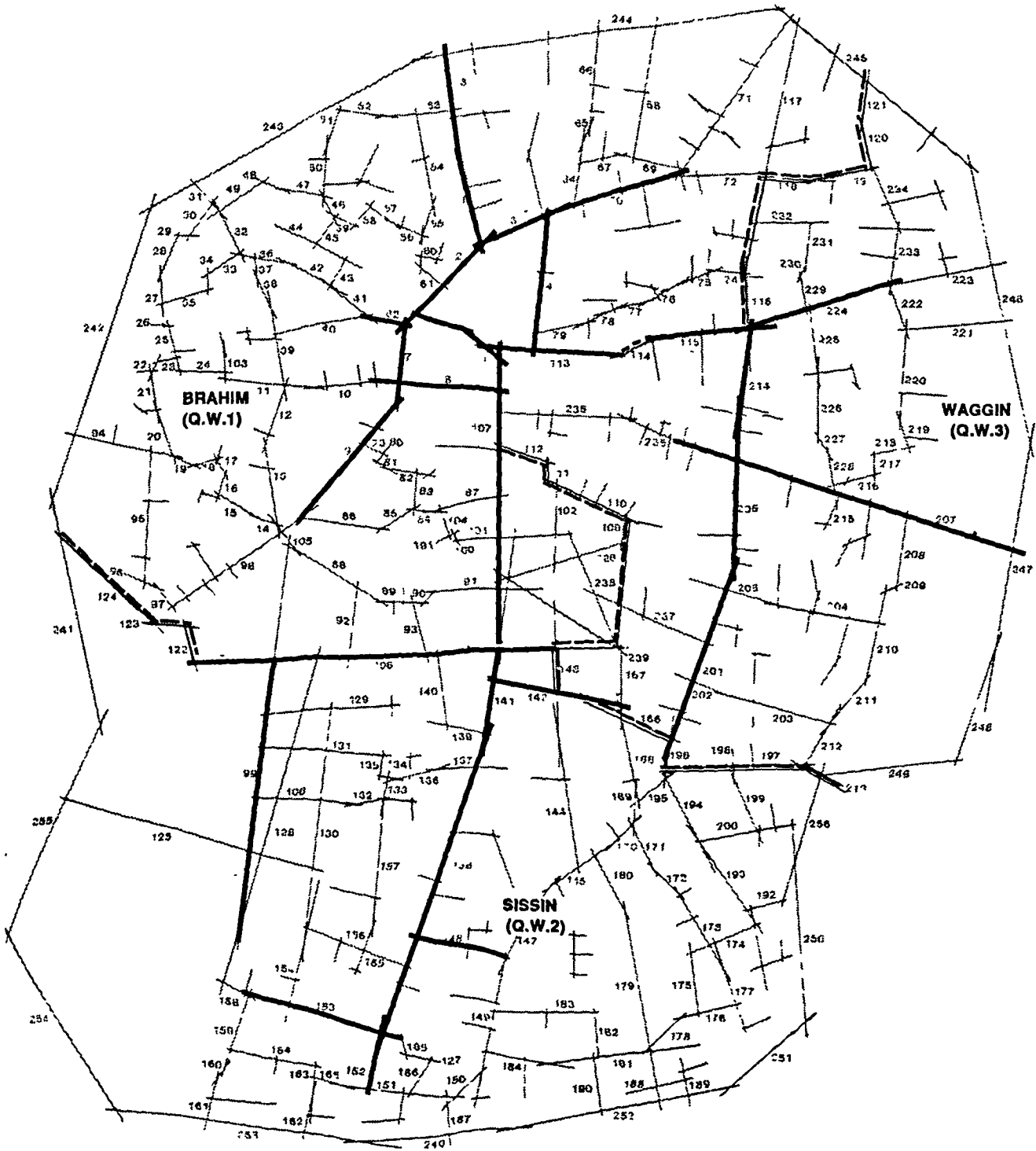


WARGLA

FIG. 3.53: AXIAL MAP



Market Streets



WARGLA

FIG. 3.54: INTEGRATION CORES (QUARTERS)

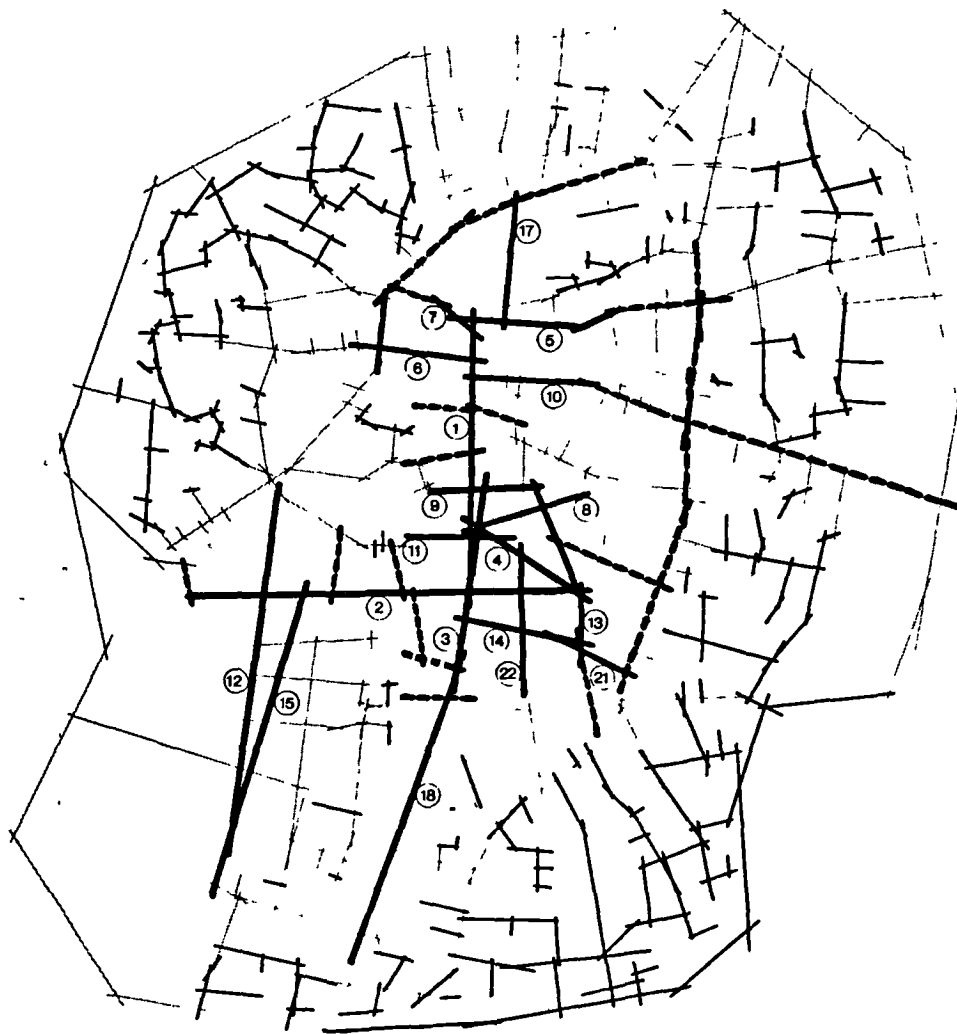
— 10% of most integrated lines



WARGLA

FIG. 3.55: INTEGRATION CORE (W.1)

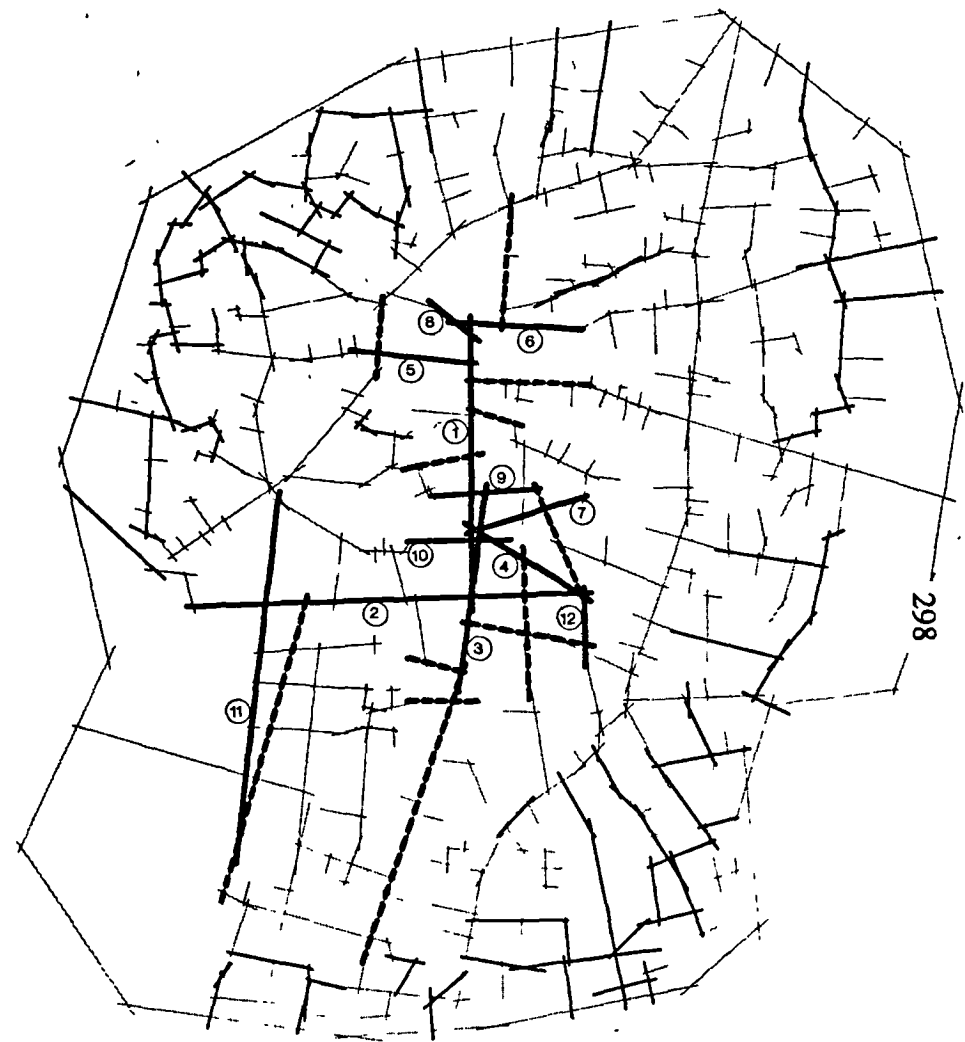
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



WARGLA

FIG. 3.56a: INTEGRATION CORE (W.2)

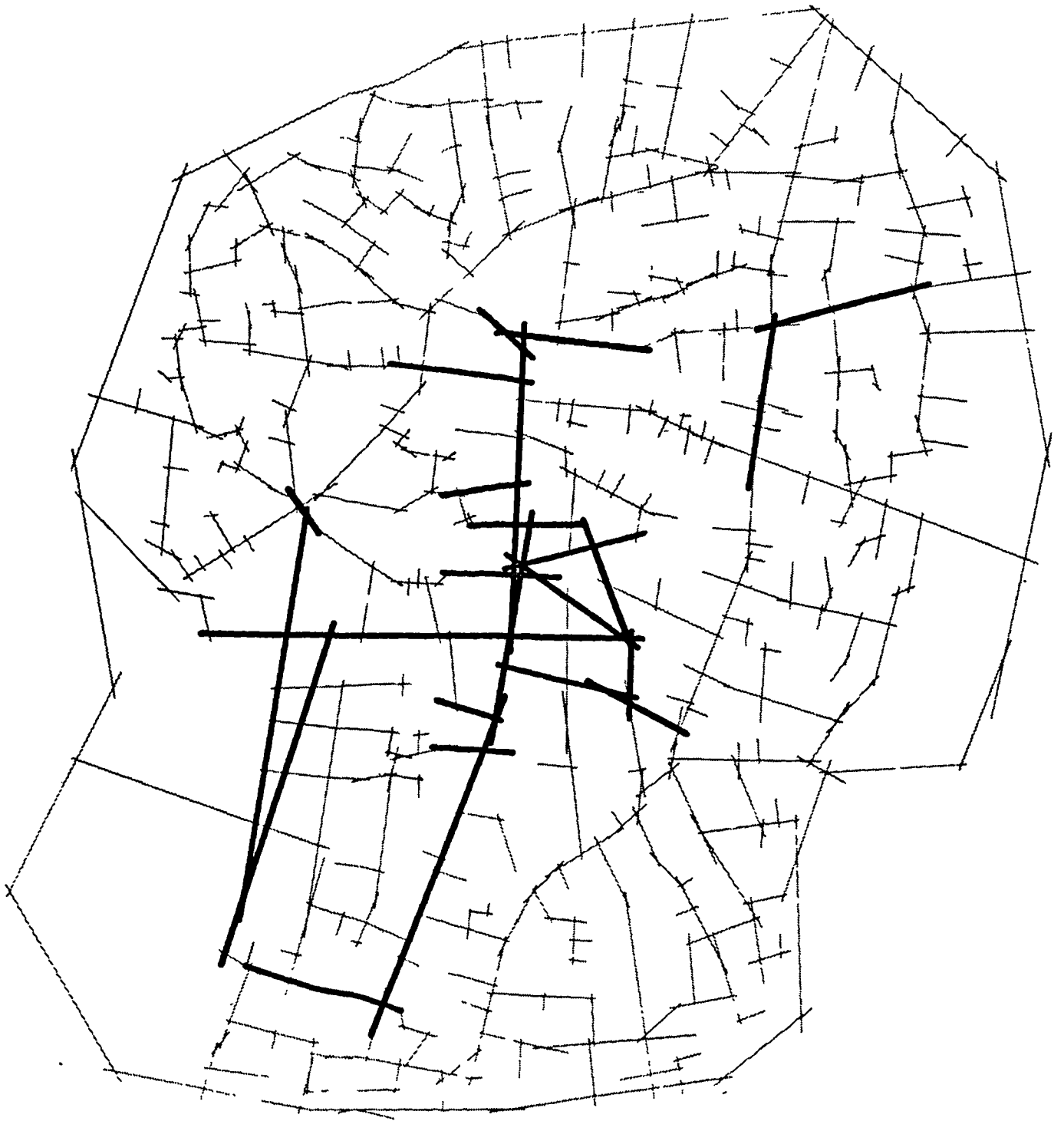
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



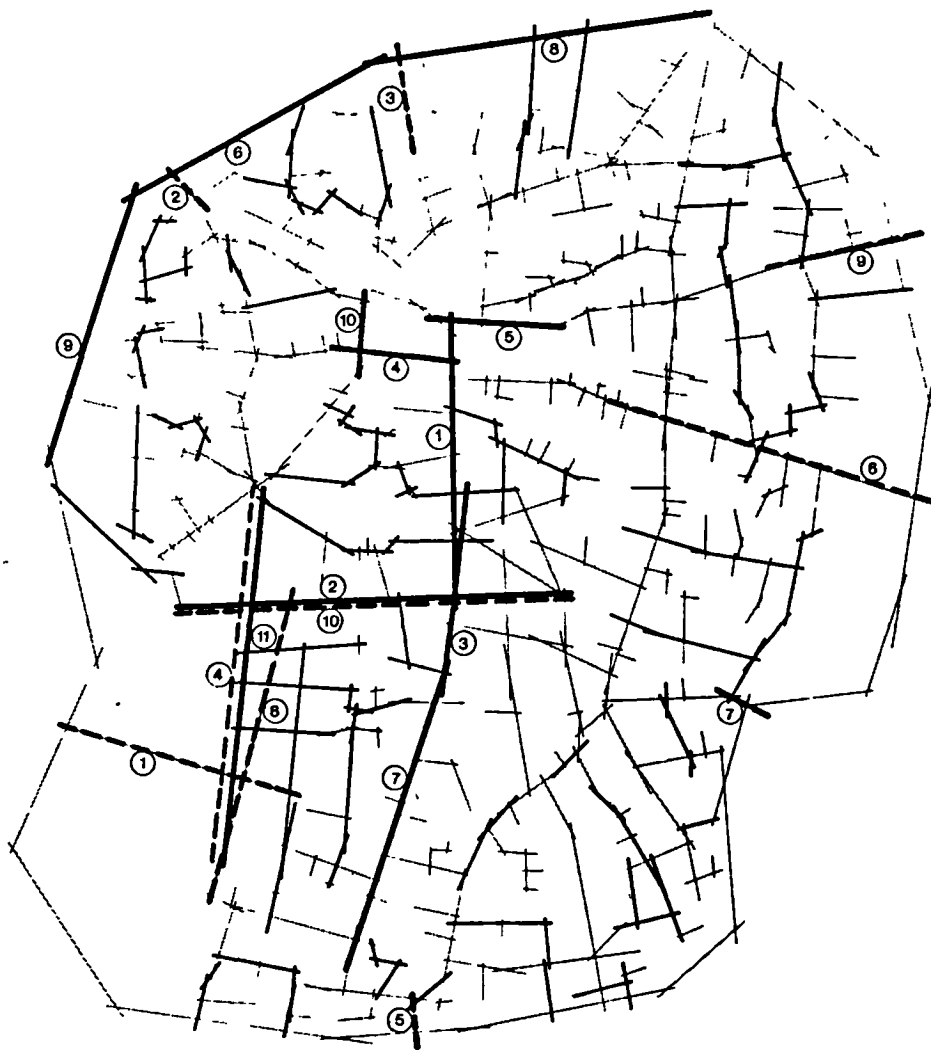
WARGLA

FIG. 3.56b: INTEGRATION CORE (W.3)

- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



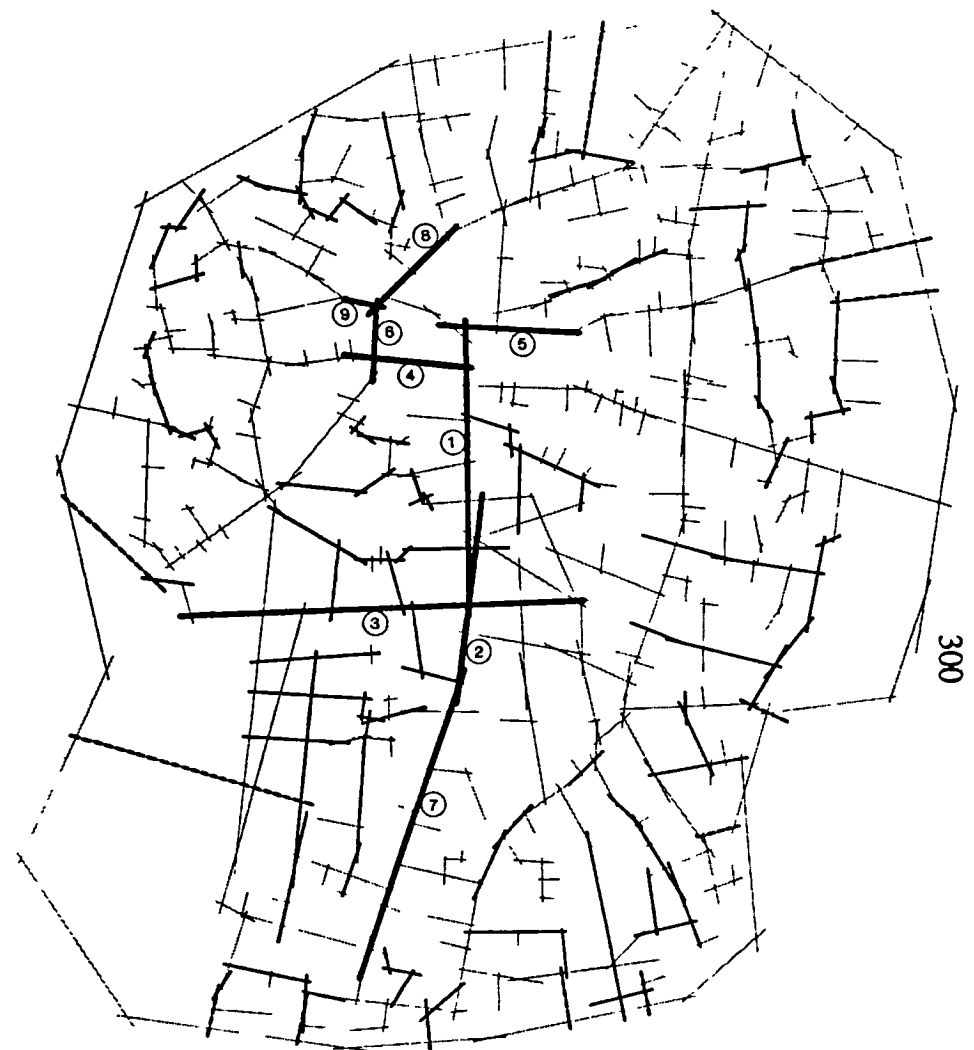
WARGLA
FIG. 3.57: RADIUS-3 INTEGRATION CORE (10%)



WARGLA

FIG. 3.58a: CHOICE AND JOURNEY PATHS

- 25% of strong choice lines
- -** Strong journey lines (equal number to strong choice lines)



WARGLA

FIG. 3.58b: CHOICE STRUCTURE (W.3)

- 25% of strong choice lines

THE TOWN OF GUEMAR:

The description of Guemar based on a visual inspection of the plan carried out in Chapter Two has already shown some fundamental differences in the street structure when compared to the other the towns. This difference is even more apparent through the axial representation of this town. The axial map in Figure 3.59 shows many long lines intersecting at right angles. But, the lines around the mosque are shorter presenting a more broken up structure than the rest of the fabric. In spite of the large number of axial long lines of this structure, the lines linking the four town gates to the inside of the system are relatively shorter and the routes they form less direct. The axial structure of this town presents several dead-end lines, but the ratio of the total number of axial lines against the distributed lines is lower than in any other previous case (1.288); and the mean depth of the non-distributed lines being also the lowest of all towns (1.2353).

SPATIAL PROPERTIES OF GUEMAR:

	G.1	G.2	G.3
K	59	76	51
MEAN CN	2.7119	2.6053	2.4314
MAX CN	5.00	6.00	5.00
MEAN RRA	1.0609	1.0633	1.3832
MAX RRA	1.3900	1.5900	2.1900
MIN RRA	0.7500	0.7700	0.8600
ST.DEV.	0.1559	0.1754	0.2839
1:RA/CN	0.7300	0.7600	0.6600
REL.INTELL.	-.0047	+.0470	-.0869
1:RA/RCH	0.8800	0.8600	0.7500
REL	+.0919	+.0936	-.0503
CN/CH	0.8100	0.8200	0.7200
CV/CH	0.6200	0.5200	0.5100

TABLE 3.19: FIRST AND SECOND ORDER MEASURES
OF GUEMAR

The results of the analyses of Guemar shown in Table 3.19 are as follows:

The town of Guemar has the lowest mean and maximum connectivity in the sample (see Table 3.1, p. 167), but a much higher level of integration than all towns previously presented; which remains fairly constant in the system analysed with the dead-end passages (G.2), but worsens when the peripheral streets are discounted (G.3) as seen in Kairwan and Susa. The maximum segregation (max. RRA) increases substantially when the peripheral streets are removed as is again the case of Susa. The relative intelligibility is about average and is identical to the relative intelligibility of Tunis and similarly to Tunis and Susa, it improves when the dead-ends are taken into account (G.2). The relative movement interface of Guemar is the highest of

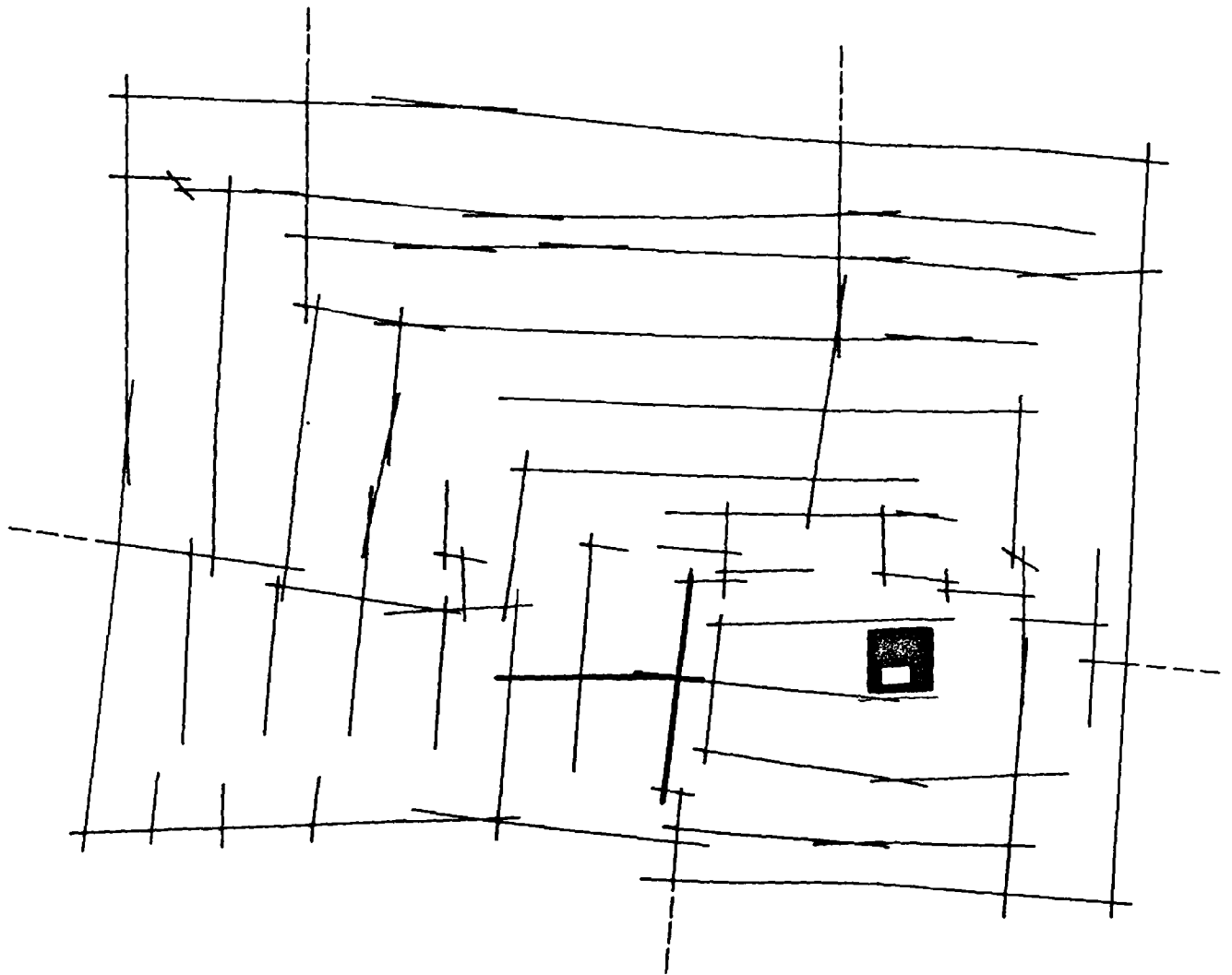
the whole sample (see Table 3.1, p. 167); and as in many cases, it decreases when the peripheral streets are removed (G.3). The system of Guemar has also the highest local predictability (CN/CH) and the highest interface potential (CV/CH) of all previous cases.

The integration core of Guemar in G.1 (see fig. 3.60) runs mainly along the periphery connecting three gatelines to a single penetrating "route". The first, second and the third most integrated spaces form a "T-like" structure directly linking the central part of the town to the periphery and to the outside, and includes none of the key town buildings; whereas the fourth most integrated line runs at the periphery close to the religious monastery which contains a college. The most segregated spaces form three small clusters, one of which traverses the market square and develops around the mosque. This is the first town when the market square and mosque emerged both segregated with respect to the whole system. When the system is taken as a whole with the dead-end lines, the core becomes discontinuous and less peripheral (see fig. 3.61a). In this case also the central part of the system remains strongly connected to the outside and to the periphery. The market and the main mosque do not in this case also, figure on the integration core. The most segregated spaces which include almost all the dead-ends are densely clustered in the oldest part of the town, surrounding the main mosque. When the peripheral streets are discounted (G.3), the core forms a tree-like structure strongly linked to the outside, but does not traverse nor lead to anywhere (see fig. 3.61b). Both the market square and the mosque remain segregated. On the other hand, the structure of radius-3 integration core shown in Figure 3.62 is made up of almost

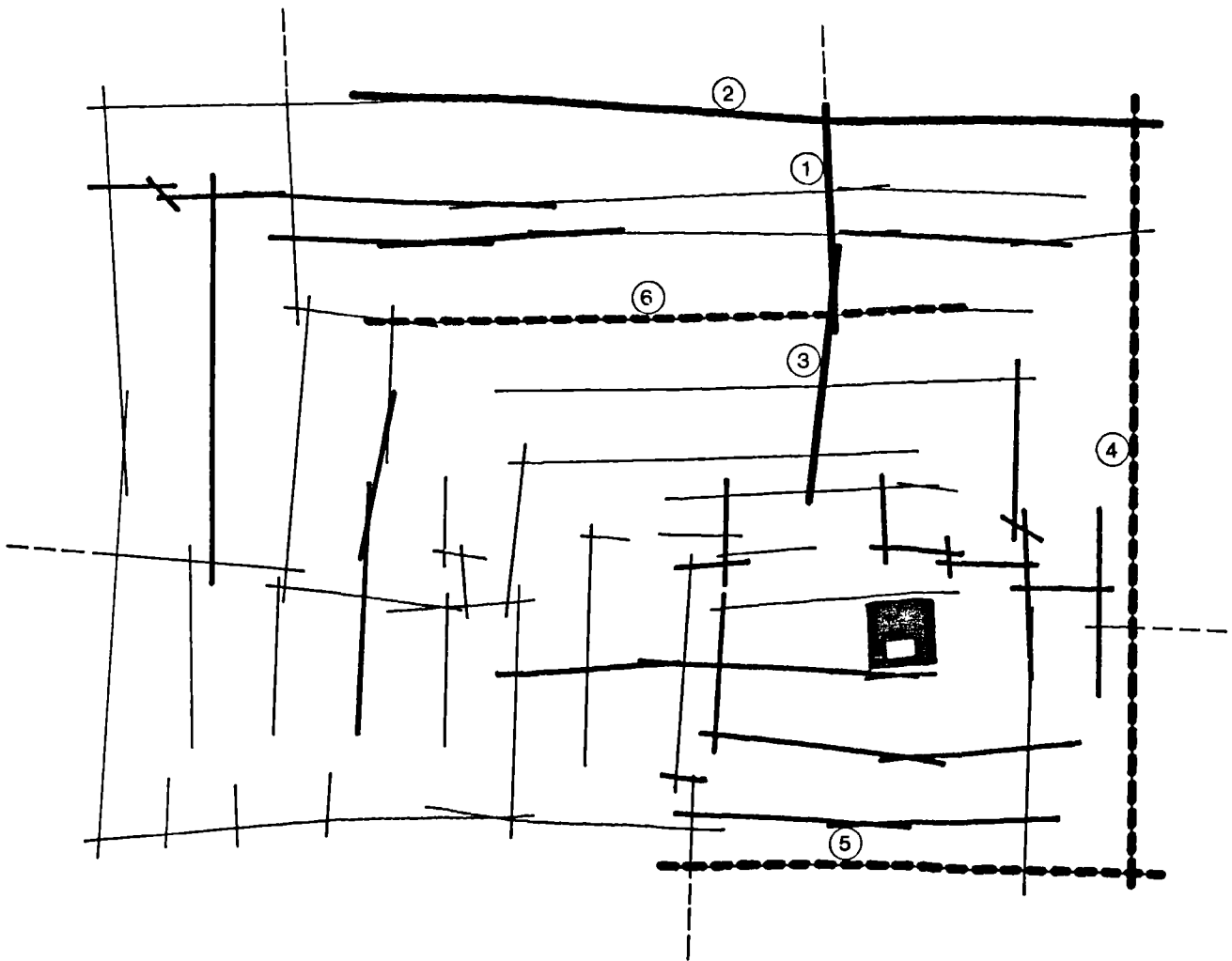
entirely of lines of radius-n core (G.1), but unlike this latter it tends to form an edge ring.

The choice structure (G.1) shown in Figure 3.63a presents strong similarities to the integration core in G1; it includes peripheral lines connected to the interior of the system by means of one penetrating "route". The market square and the mosque are not on the choice structure. The best lines of the journeys path form a discontinuous structure away from the market place and the great mosque. The map suggests also a relatively poor interface between the two types of paths (correlation=0.538; see graph in Appendix 2). When the peripheral streets are omitted (G.3), the choice structure does not vary strongly from G.1 (see fig. 3.63b). In this case (G.3), the correlation (0.3601) between the two quantities becomes weaker showing that the relatively higher correlation in G.1 was only created by the peripheral streets. This suggests that the possible interface between the choice and the random journeys from the outside is likely to take place only at the periphery of the town.

In conclusion, despite the more regular structure of the grid of Guemar as indicated by the numerical properties, the general aspect of the run of the core might be seen, from the spatial evidence alone, to be geared more towards the control of the movements of strangers, as the core in all three analyses remains confined to a particular part of the system including the periphery, and is clearly cut from the main public amenities of the town. Another prominent feature in the grid structure of this town is the high segregation of the mosque and the market square with respect to the town as a whole.



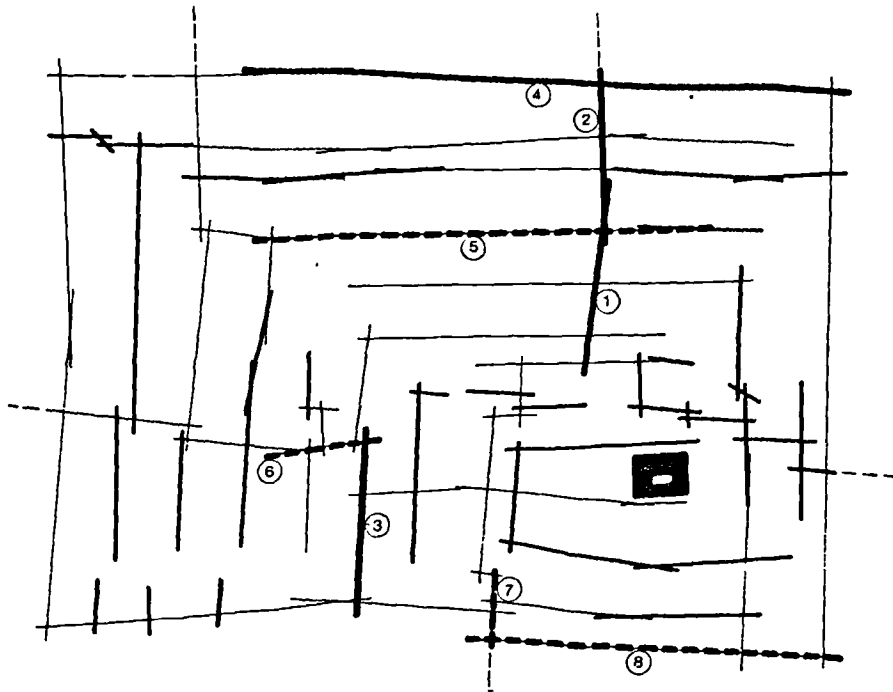
GUEMAR
FIG. 3.59: AXIAL MAP
Market Streets



GUEMAR

FIG. 3.60: INTEGRATION CORE (G.1)

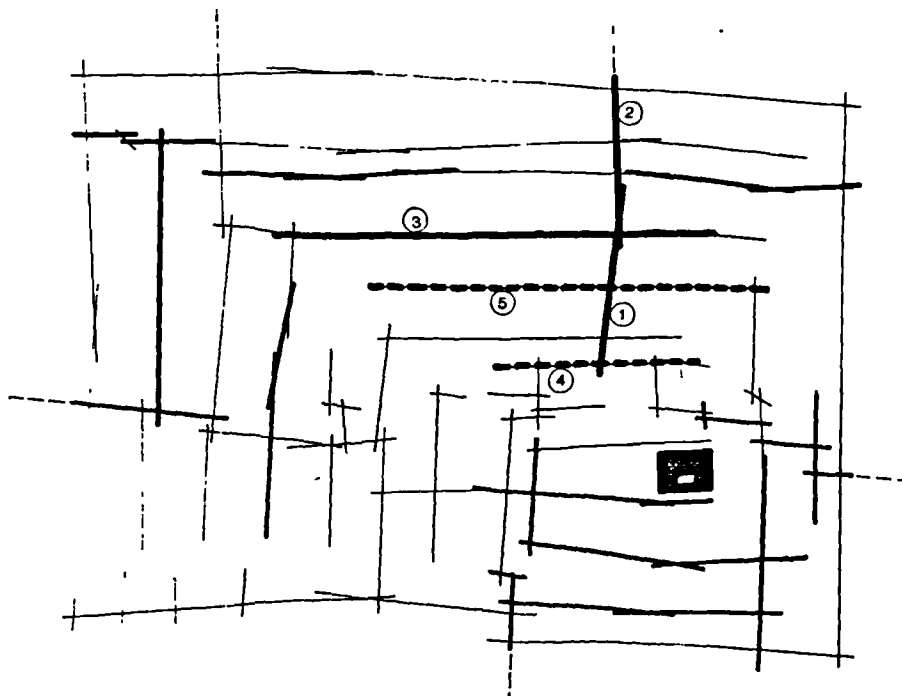
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



GUEMAR

FIG. 3.61a: INTEGRATION CORE (G.2)

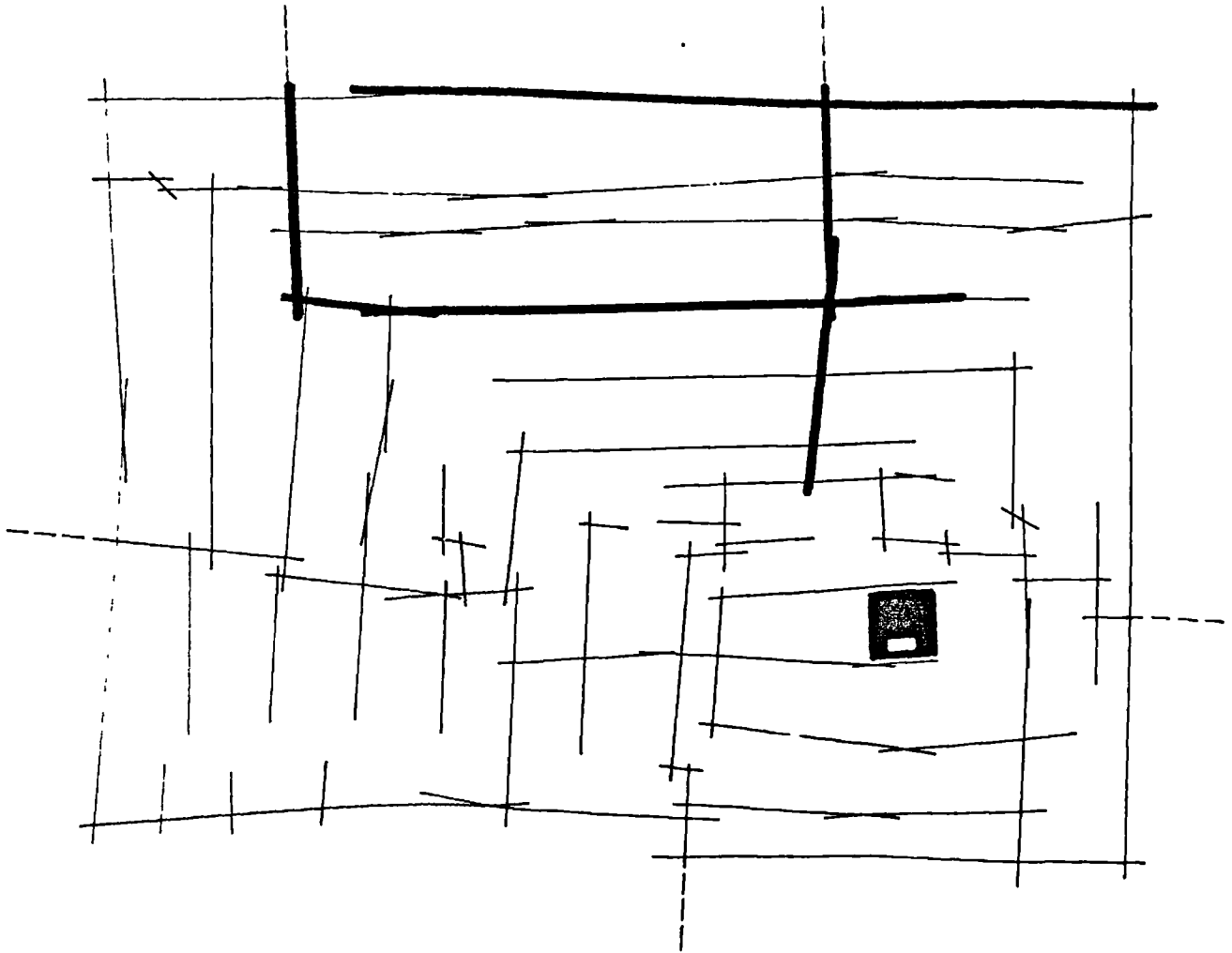
- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



GUEMAR

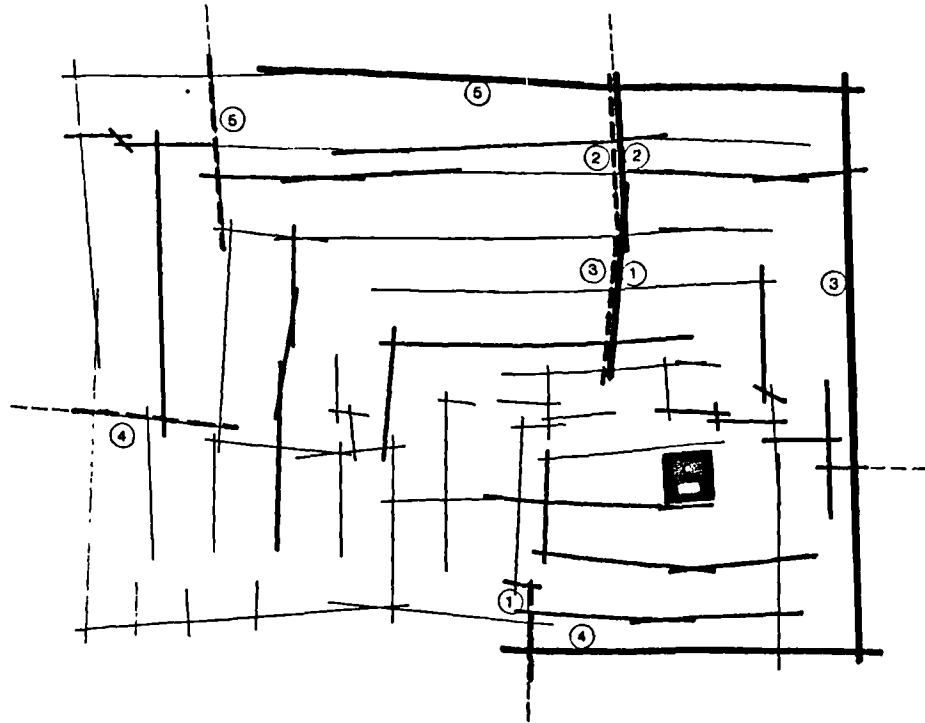
FIG. 3.61b: INTEGRATION CORE (G.3)

- 5% of most integrated lines
- - 10% of most integrated lines
- 50% of most segregated lines



GUEMAR

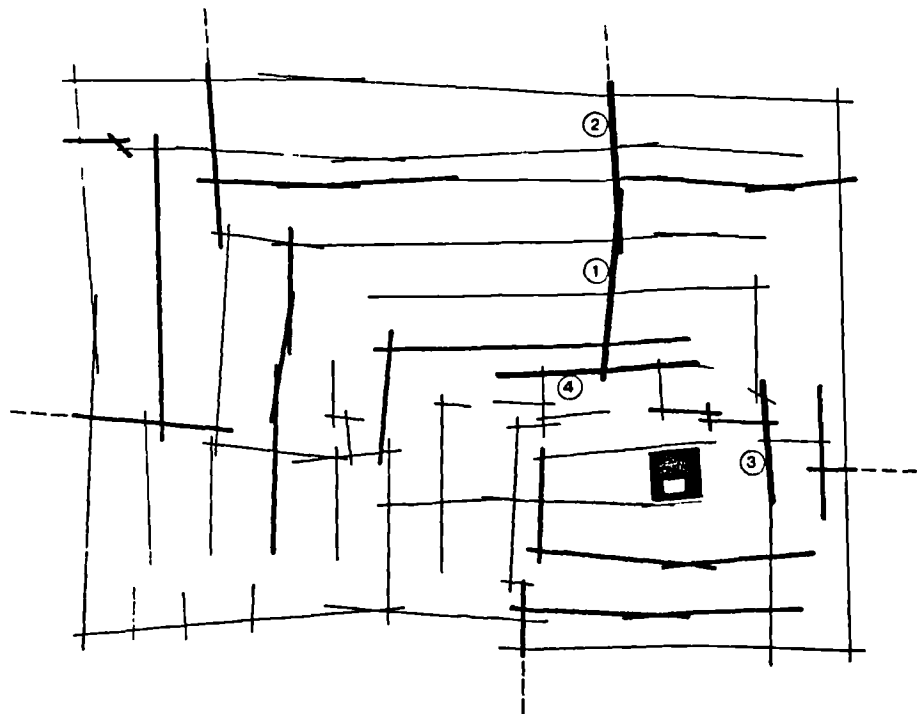
FIG. 3.62: RADIUS-3 INTEGRATION CORE (10%)



GUEMAR

FIG. 3.63a: CHOICE AND JOURNEY PATHS

- 25% of strong choice lines
- - Strong journey lines (equal number to strong choice lines)



GUEMAR

FIG. 3.63b: CHOICE STRUCTURE (G.3)

- 25% of strong choice lines

THE TOWN OF TAMELHAT:

As already pointed out, the overall structure of the axial grid of Tamelhat as the case of Guemar, presents a great deal of regularity with long straight lines defining long and narrow islands. But as in Guemar, the structure of the area around the mosque is distinctly different, showing shorter lines meeting at irregular angles (see fig. 3.64). It is also the only area of the system which contains the few dead-end lines. With a high mean depth (1.8571), the highest after Fez, this system has the lowest ratio (the total number of axial lines against the number of distributed lines) of all towns (1.241).

SPATIAL PROPERTIES OF TAMELHAT:

	TAM.1	TAM.2	TAM.3
K	58	72	53
MEAN CN	3.4828	3.1944	2.9057
MAX CN	11.00	11.00	9.00
MEAN RRA	0.8475	0.9680	1.0430
MAX RRA	1.3800	2.0500	1.9700
MIN RRA	0.5200	0.5600	0.5800
ST.DEV.	0.2047	0.2944	0.2727
1:RA/CN	0.7900	0.7400	0.7200
RELINTELL.	+.0538	+.0223	-.0236
1:RA/RCH	0.5900	0.4500	0.5700
REL	-.1995	-.3210	-.2271
CN/CH	0.7000	0.6600	0.6800
CV/CH	0.7400	0.7100	0.6500

TABLE 3.20: FIRST AND SECOND ORDER MEASURES OF TAMELHAT

The results of the analyses of Tameihat are summarized in Table 3.20 which shows the highest mean connectivity of the whole and also the second highest maximum connectivity after Wargla (see also General Data Table 3.1, p.167). The table shows also the highest mean integration of all, which is even higher than the urban average (0.9337). The mean integration decays when the dead-ends are added (TAM.2) by contrast to many other towns, and also when the peripheral streets are disregarded (TAM.3).

Tameihat has also the highest relative intelligibility in the sample and the lowest relative movement interface of all which markedly decay when the dead-ends are added. In this town, the local predictability is relatively high compared to Algiers, Fez or Constantine; but the interface potential is the highest of all.

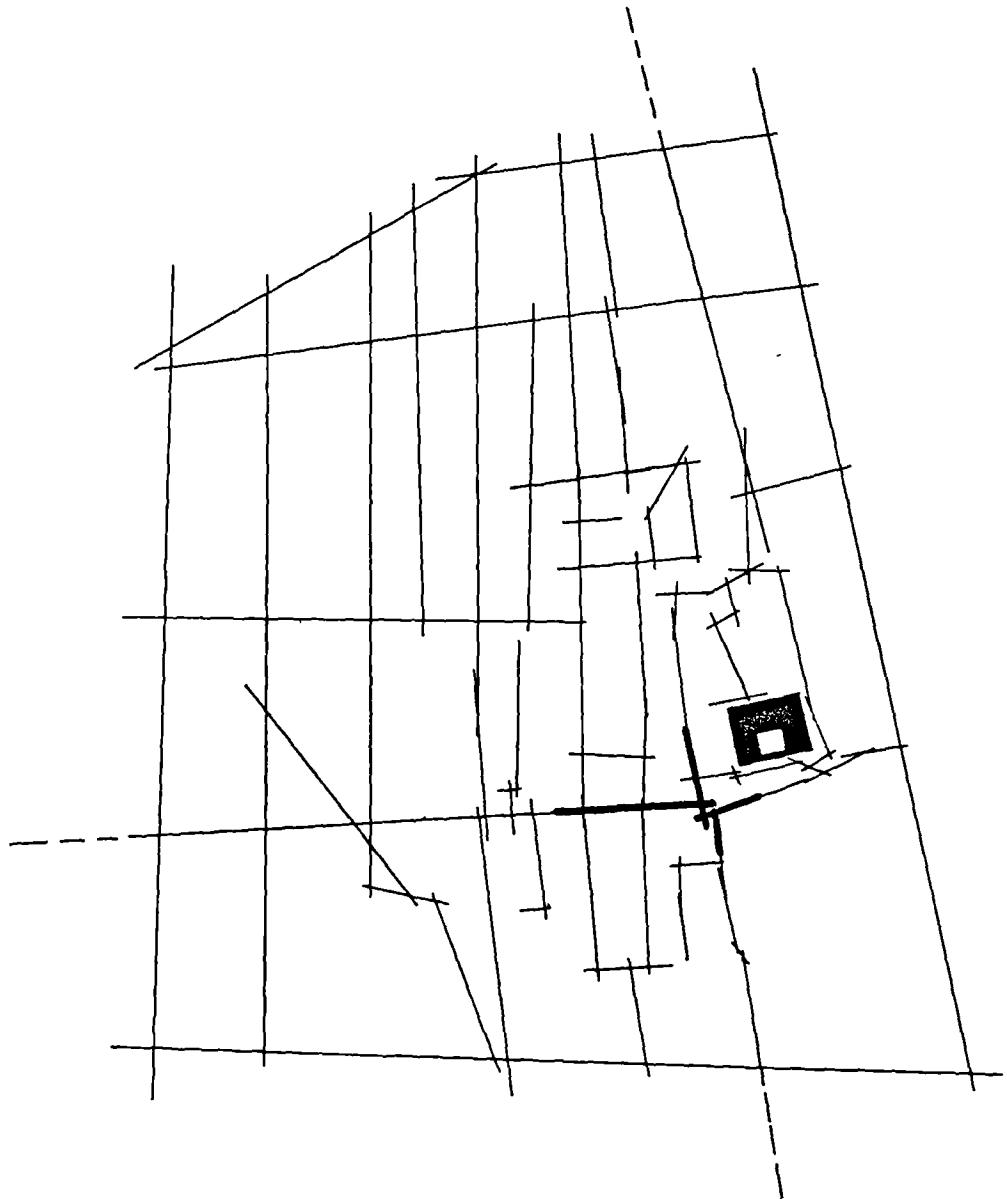
Figure 3.65 shows the integration core of Tameihat in which the first three best integrated lines constitute an orthogonal structure traversing the town and strongly connecting the peripheral streets to the inside of the system. The integration core forms a continuous structure running along the peripheral areas with a penetrating line strongly connecting the market place to the outside. The mosque which is in geographical terms fairly close to the market square, is strongly segregated as in Guemar or Sale, with the 1st and 2nd most segregated lines being around the mosque. The most segregated spaces form a cluster around the religious buildings (mosque, colleges and monastery). When the dead-ends are taken into consideration (TAM.2), the four best integrators remain about the same, but the two peripheral streets are no longer part of the

integration core which is now more internal (see fig. 3.66a). The first integrator which runs partly along the market streets still connects the market place to the outside. When the peripheral streets are removed (TAM.3), the mosque remains segregated and the market area becomes more integrated and still directly links to the outside (see fig. 3.66b). But the structure of radius-3 integration core (see fig. 3.67) is not substantially different from radius-n core of TAM.1 and as in radius-n core, it includes the market square but not the mosque.

The strong choice lines shown in Figure 3.68a intersect at the market place and strongly connect to the outside. The third strong choice line traverses the northern part of the town. The mosque and the religious buildings do not figure on the choice path. The best lines of the journeys path correspond to the best line in terms of choice and intersect also at the market place as in Wargla. The correlation (0.8353) between the two measures, the highest of all towns, suggests a strong overlap. This is supported by the related graph (see scattergram in Appendix 2) which shows a consistent tendency of the points to form a linear pattern.

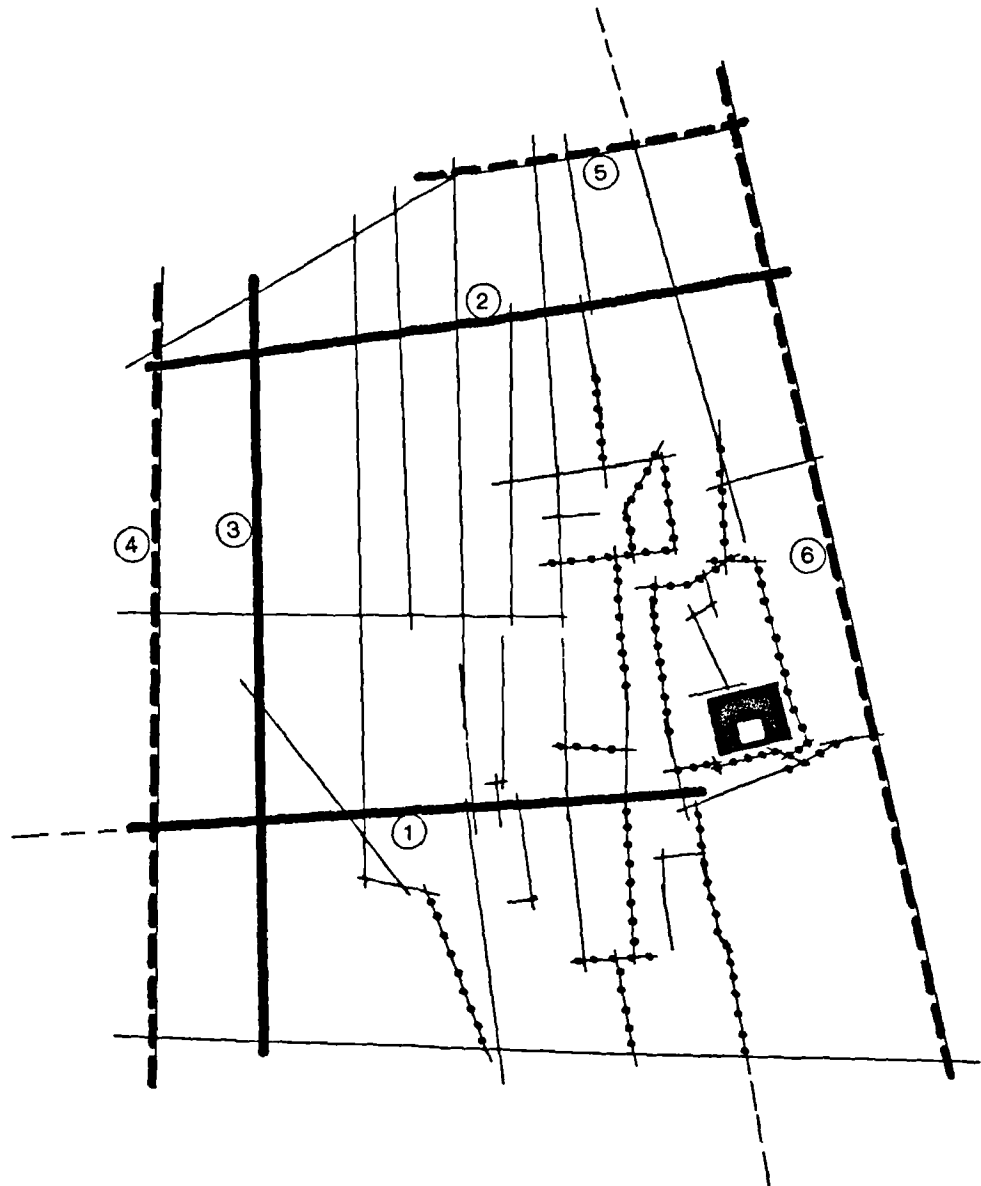
The choice path in the system without the periphery (TAM.3) also develops in the market area (see fig. 3.68b). The best line in terms of choice and journey directly links the market area to the outside. The correlation ($r=0.8565$) between the two spatial measures does not decay when the peripheral streets are discounted, indicating then a strong interface which is not created by the periphery, and is likely to take place in the market area away from the mosque.

In conclusion, the system of Tamelhat presents a peripheral and penetrating core which excludes the mosque and strongly connects the market area to the periphery and to the outside. The above measures indicate a totally different type of urban grid from all the previous towns including Guemar which appears to display to a visual inspection, some similarities in the morphological characteristics. It is the only case which presents a remarkably high level of integration and the highest relative intelligibility, but also the lowest of all relative movement interface.



TAMELHAT

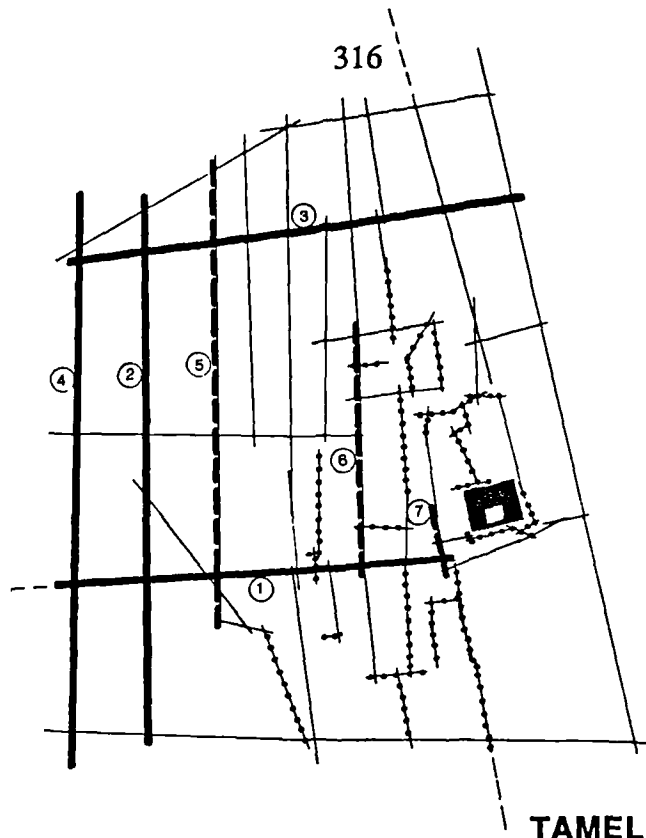
FIG. 3.64: AXIAL MAP
Market Streets



TAMELHAT

FIG. 3.65: INTEGRATION CORE (TAM.1)

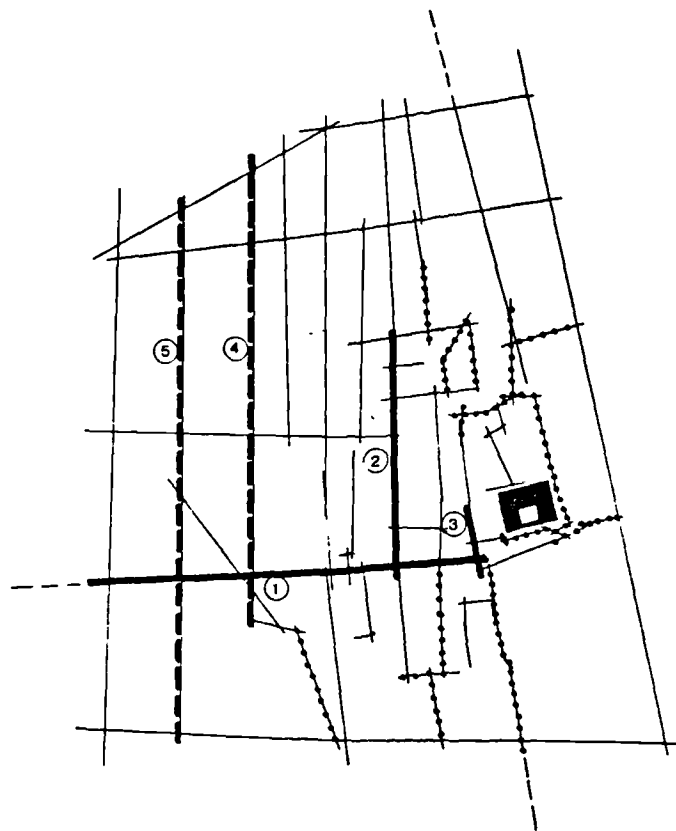
- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines



TAMELHAT

FIG. 3.66a: INTEGRATION CORE (TAM.2)

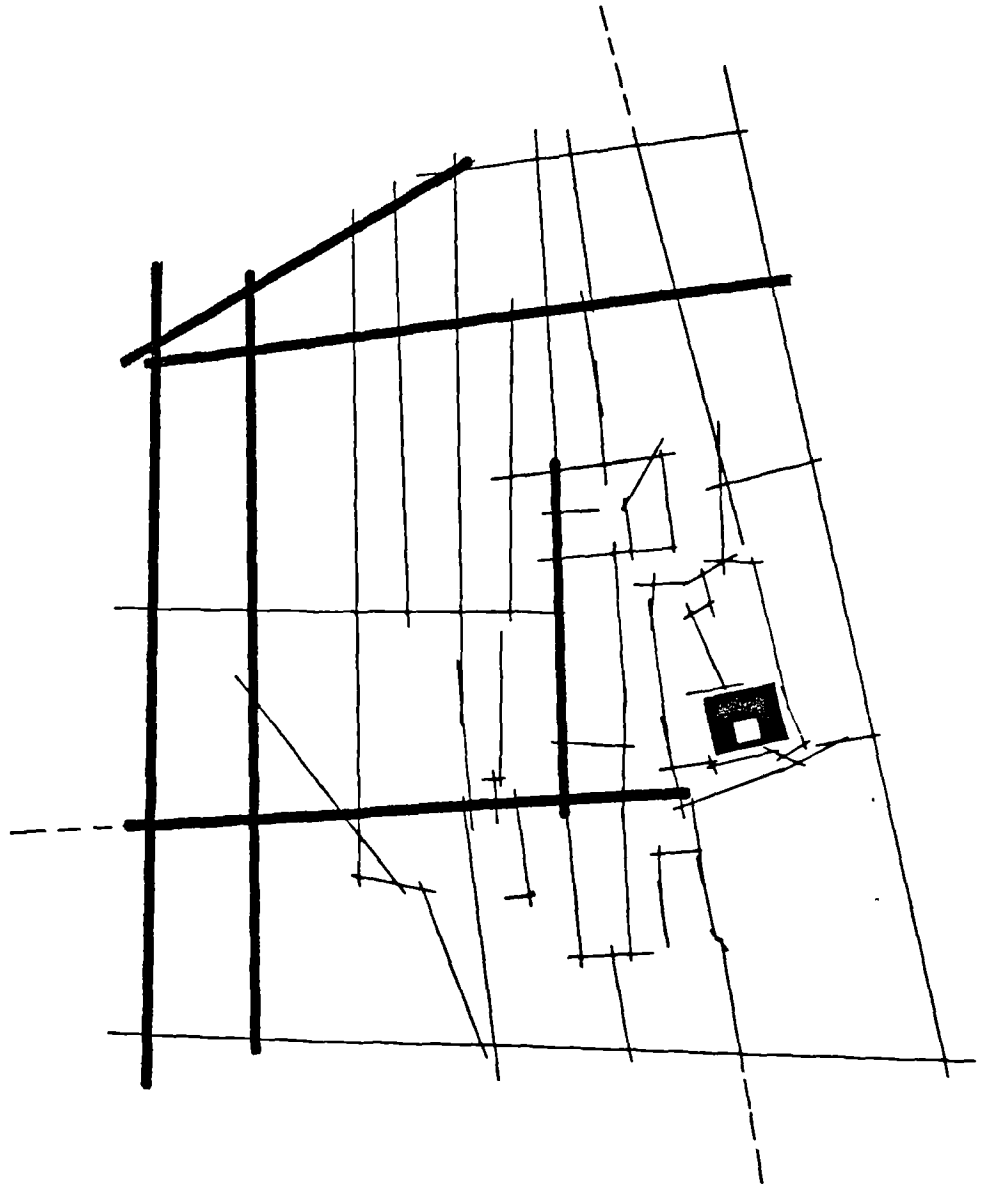
- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines



TAMELHAT

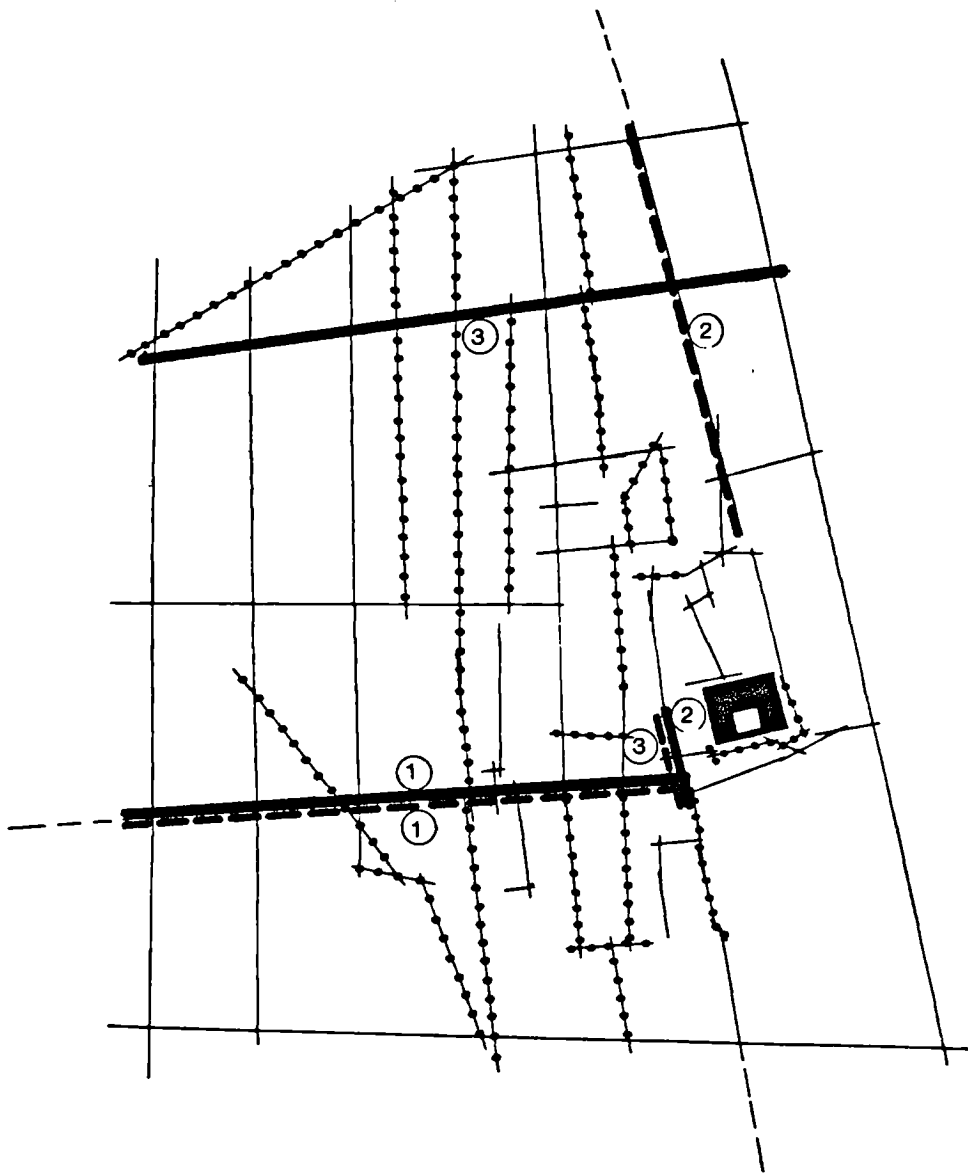
FIG. 3.66b: INTEGRATION CORE (TAM.3)

- 5% of most integrated lines
- - 10% of most integrated lines
- ... 50% of most segregated lines



TAMELHAT

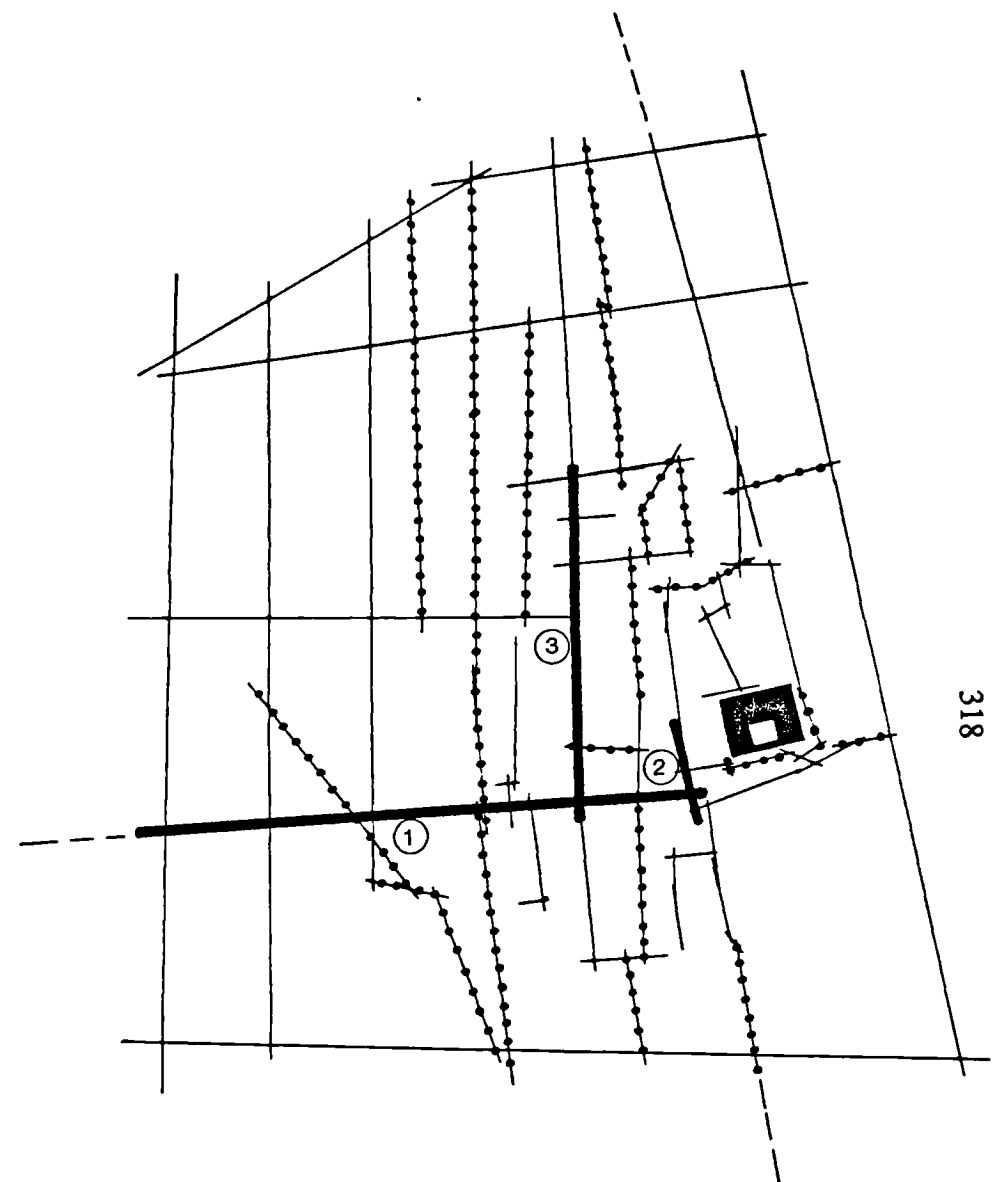
FIG. 3.67: RADIUS-3 INTEGRATION CORE (10%)



TAMELHAT

FIG. 3.68a: CHOICE AND JOURNEY PATHS

— 25% of strong choice lines
 - - Strong journey lines (equal number to strong choice lines)



TAMELHAT

FIG. 3.69b: CHOICE STRUCTURE (TAM.3)

— 25% of strong choice lines

CHAPTER THREE: PART TWO : A "NUMERICAL PICTURE" OF THE URBAN GRID OF ARAB TOWNS

The second part of the present chapter aims to see how the typological features of the grid structure of Arab towns defined in terms of relational consistencies of grid elements and expressed quantitatively, can be confirmed by such an analysis. In other words, the question to be addressed in the following section is that can the genotypical properties of Arab towns be formally demonstrated? For this purpose, it is suggested to examine the properties of the 12 towns taken as a group against the background of the measures of the 75 urban systems, considered as urban averages (*).

The analytical results of the towns considered as one group are therefore compiled into a "synoptic data file" where the means of the measures and their statistical derivatives for the whole sample are computed. The spatial measures are generated on the basis of the axial maps of the distributed system of the towns (i.e., V.1). In order to establish what is distinctive about these systems in terms of how the "parts" form the "wholes", the analytical measures are correlated with size and cross-examined against the results shown by the synoptic data file grouping the 43 sub-areas, that is the 43 "parts" which they are made of. This follows the like taken in the analysis of the 75 urban systems, in order to compare the results with the key results of that study. The analytical procedure is as follows:

(*) For full details of the studies of the 75 urban systems, the reader is referred to the SERC report, 1986, Unit of Architectural Studies, UCL; or "Architecture and Behaviour", vol. 3, July 1987, pp. 233-250.

First: i- to examine the means and distribution of connectivity (CN) and integration (RRA) for the sample of the 12 Arab towns, and see how far they correlate with size, as given by $\log K$ (K being the total number of axial lines of the systems as in Version 1);

ii- to examine the means and distribution of the "second order" measures (i.e. intelligibility; movement interface; local predictability; and interface potential) of the 12 urban systems; and see the extent to which they correlate with size of the systems, controlling for the mean integration;

iii- to examine the degree to which the mean integration correlates with the second order measures, in each case controlling for size;

iv- to see how far the second order measures correlate with each other, in each case controlling for size and mean integration.

Second, to examine: i- the first and second order measures of the two samples, that is the 12 large systems against those of the sample of 43 sub-systems, each taken as a group, and see how far they differ from each other.

ii- to see how far the second order measures in the sample of the 43 sub-areas, correlate with size controlling for mean integration; and how far the first order measures correlated with second order measures, in each case controlling for $\log K$ and for mean integration.

When the 12 systems are taken as a group, their spatial properties appear strikingly different in terms of first and second order measures compared to the sample of the 75 urban systems (SERC

Report, 1986; also Hillier B. et al., 1987, pp. 233-250). The key results are set up in the following tables.

MEANS OF	K	CN	RRA	CN	CH
MEAN	349	3.076	1.421	1.000	0.030
r : logK(*)	-	-.1254	-.7240	-	-.7880
MAX	723	9.333	2.119	2.976	0.261
r : logK	-	0.1954	0.704	0.2265	-.0512
MIN	58	1.583	0.982	0.290	0.000
r : logK	-	-.5508	0.7017	0.3427	-.5084
ST.DEV.(*)		1.327	0.232	0.402	0.041
r : logK		-.2052	0.4286	-.3429	-.6720

TABLE 3.21a: MEANS OF FIRST ORDER MEASURES FOR THE 12 TOWNS

MEANS OF	K	CN	RRA	CV	CH
MEAN		3.5955	0.9337	1.000	0.0472
r : logK	-	0.1968	-.0525	-	0.6546
MAX	900	14.280	1.5316	4.6192	0.348
r : logK	-	0.7648	0.0266	0.7580	-.039
MIN	20	1.1333	0.5629	0.1600	0.000
r : logK	-	-.1533	-.0592	-.3700	-
ST.DEV.	-	2.2079	0.2030	0.7004	0.0639
r : logK		0.4045	-.1782	0.3274	0.7365

TABLE 3.21b: MEANS OF FIRST ORDER MEASURES FOR THE 75 URBAN SYSTEMS (SERC REPORT, 1986, p.9)

The mean (of the means) connectivity of the 12 systems (3.076) is markedly lower than in the sample of the 75 urban systems, and does

(*) "r : logK" stands for correlation with log K; and "ST.DEV." stands for standard deviation.

not correlate with size (-0.1254), as is the case of the 75 systems (see Table 3.21b). The mean maximum connectivity (9.333) for the 12 towns is much lower than in the sample of the 75 urban systems, and does not correlate with size (0.1954) compared to the strong correlation for the 75 systems. Even more strikingly, the mean integration (1.421) of the 12 systems is very weak compared to the average of the 75 systems (.9337) and strongly correlates with size (0.7040) by contrast to the 75 urban systems where there is no correlation. The (mean of) maximum and minimum segregation (2.119 and 0.982) for the 12 towns are also markedly higher than those in the 75 systems, and also strongly correlate with size (0.704 and 0.7017), compared to the 75 systems (see Table 3.21b).

From these results, it can be safely inferred that: first, the degree of difference in the above measures between the two samples is sufficient and sufficiently consistent to suggest that the towns under study present distinct features in the structuring of their urban grid. Second, the results also suggest a significant difference between the two samples, in the relationship of the measures to size. Two key differences are that Arab towns seem to grow larger without increasing significantly their maximum connectivity (the correlation of mean MAX. CN with logK being only -0.1254), but decreasing their level of integration (the correlation of mean RRA with logK being 0.7240). In other words, the larger these systems are the more segregated they tend to become.

Table 3.22a sets up the second order measures and their correlations with size and mean integration of the 12 systems, in each case controlling for mean integration and size given by Log K, in order to

preserve comparability with the study of the 75 systems. The results are:

MEAN OF	1:RA/CN	1:RA/RCH	CN/CH	CV/CH
MAX	0.788	0.875	0.812	0.739
MEAN	0.536	0.621	0.637	0.509
MIN	0.296	0.434	0.488	0.330
ST.DEV.	0.156	0.146	0.121	0.123
r : K (*)	-.6636	-.5680	-.7169	-.7786
r : log K	-.8490	-.6053	-.7574	-.8663
r : log K controlling for mean RRA	-.6726	-.3204	-.4918	-.7023
r:mean RRA	-.7623	-.5995	-.7328	-.8033
r:mean RRA control for logk	-.5462	-.3246	-.4446	-.5535
r:(1:RA/CN)	-	0.5000	-	0.8210
r:(1:RA/CN) control for logK	-	0.1899	-	0.7687
r:(1:RA/CN) control for mean RRA	-	0.0767	-	0.6879

TABLE 3.22a: MEANS OF SECOND ORDER MEASURES FOR THE 12 LARGE SYSTEMS AND RELATIONS WITH SIZE AND MEAN INTEGRATION

(*) In the table, "r : K" or "r : mean RRA" refer to the correlation with the specified measure.

MEAN OF	1:RA/CN	1:RA/RCH	CN/CH	CV/CH
MAX	0.9487	0.9241	0.9284	0.9800
MEAN	0.6863	0.7400	0.7675	0.6789
MIN	0.3564	0.3162	0.1224	0.0447
ST.DEV.	0.1740	0.1910	0.1830	0.2196
r : K	-.5516	-.5869	-.1318	-.0643
r : log K	-.7053	-.7630	-.2279	-.1546
r : log K controlling for mean RRA	-.7694	-.7633	-.3594	-.3023
r:mean RRA	-.5271	0.0024	-.7155	-.8022
r:mean RRA control for logk	-.7135	0.0343	-.7428	-.8174
r:(1:RA/CN)	-	0.7870	-	0.600
r:(1:RA/CN) control for logK	-	0.5431	-	-
r:(1:RA/CN) control for mean RRA	-	0.8451	-	-

TABLE 3.22b: MEANS OF SECOND ORDER MEASURES FOR THE 75 URBAN SYSTEMS
AND RELATIONS WITH SIZE AND INTEGRATION

The (mean of means of) intelligibility (1:RA/CN) of the 12 towns is markedly lower than in the 75 urban systems. It strongly correlates with size ($r: \log K = -.849$), more than in the case of the 75 systems. This weakens when the mean integration is controlled for ($-.6726$), in contrast to the 75 systems where it becomes markedly stronger. The intelligibility in the 12 towns also correlates with the level of integration ($-.7623$), but this also decays when size is controlled for ($-.5462$), indicating then that both size and integration are related to the level of intelligibility, by contrast to the 75 urban systems where this measure is much more related to the degree of integration than

size, as shown by the correlation with the mean integration (-.5271) which improves (-.7135) when the effect of size is controlled.

The (theoretical) "movement interface" (1:RA/RCH) for the 12 towns taken as a group is also relatively weak when compared to the 75 systems. It correlates with size (-0.6053) but not as strongly as is the case of the 75 systems, and considerably weakens (-0.320) when the mean integration is controlled for. The correlation of the movement interface with the mean integration (-0.5995) weakens also when controlling for size (-0.3246), indicating that the movement interface appears to be equally affected by the mean integration of the systems and their size. This is another different result from the 75 systems where the "movement interface" is much more affected by size than integration, as can be shown by both the strong correlation with size (-0.7633) controlling for mean integration, and the non-correlation with the mean integration (0.0024) when the effect of size is discounted.

The local predictability (CN/CH) of the sample of the 12 towns is also weak in comparison to the 75 systems. This measure correlates strongly with size, again in contrast to the 75 systems. It also strongly correlates with the mean integration (-.7328), falling considerably when the effect of size is removed (-0.446). Conversely, in the case of the 75 urban systems, the local predictability (CN/CH) is much more related to the level of integration than to size. This is shown by the strong correlation with the mean integration, which improves when size is controlled for, and also by the weak correlation with size.

The interface potential (CV/CH) for the 12 towns is also weak compared to the 75 systems, and correlates strongly with size (-0.8663) unlike the 75 systems (see Table 3.22b), weakening but only slightly (-.7023) when the mean integration is controlled for. This measure also correlates strongly with mean integration (-0.8033), but this decays markedly (-0.5535) when the effect of size is discounted. This suggests that for the 12 Arab towns the level of interface potential is more affected and determined by size than integration, unlike the 75 urban systems where the results showed that the interface potential is much more related to the level of integration than size.

Table 3.22a gives also the correlation between the level of intelligibility (1:RA/CN) of the 12 towns and their movement interface (1:RA/RCH) which is much weaker (0.500) than in the 75 systems and totally disintegrates when controlling for either size (0.1899) or mean integration (0.0767). These are two entirely contradictory results to the 75 urban systems where a strong correlation was found between the two measures, which led to one of the important conclusions of the SERC report: that for the 75 urban systems the level of intelligibility governs to a large extent, the degree of (theoretical) movement interface (SERC Report, 1986, p. 13 and p. 42). In Arab towns, the level of intelligibility in fact strongly correlates with the interface potential (0.826) in contrast to the 75 systems (0.60). It weakens slightly (0.7687) although remaining strong, when controlling for size, and more markedly when controlling for mean integration. This suggests that the level of integration creates the intelligibility in Arab towns which in turn determines to a certain extent, the level of interface potential.

These results suggest certain clear conclusions: first, the 12 towns under study when taken as a group have been found to be highly segregated, less intelligible and present a much lower movement interface both locally and globally, when compared to the 75 urban systems. Second, that in contrast to the 75 urban systems, the level of intelligibility of the 12 Arab towns does not seem to control their degree of movement interface (1:RA/RCH), that is the theoretical inhabitants-strangers interface. However, the intelligibility of the 12 towns correlates strongly with the interface potential (CV/CH), suggesting therefore that the intelligibility in these towns seem to control more the interface potential between the inhabitants mainly because the interface potential is the local-global "dynamic" measure; that is the interface between the local movements (by definition of the inhabitants) and the global movements of inhabitants. Third, the 12 Arab towns are strongly affected by size: that is the bigger they are, the more segregated they tend to become and the weaker their intelligibility and movement interface. The level of interface potential and local predictability appear also to be more affected by the size of the systems than by their degree of integration. What this suggests in the light of the results of the analysis of the towns taken as a group, is that these systems seem in general, to grow by adding more elements without introducing a higher order, to control effectively the morphological effects of growth; that is without increasing the connectivity of the already well connected lines of the systems.

This can be further examined through the results of the analysis of the 43 quarters that constitute the 12 towns, compiled into a synoptic data file and summarized in Tables 3.23 to 3.24 .

MEAN OF	CN	RRA	CV	CH
MEAN	2.789	1.386	1.000	0.080
r : logK	0.3111	0.3341	-	-0.6818
MAX	6.136	2.060	2.207	0.364
r : logK	0.4430	0.3827	0.2365	-.3014
MIN	1.864	0.901	0.462	0.003
r : logK	-.1551	0.2990	-.423	-.406
ST. DEV.	0.997	0.282	0.340	0.076
r : logK	0.3279	0.226	0.0233	-.5444

TABLE 3.23: MEANS OF FIRST ORDER MEASURES FOR THE 43
QUARTERS (LOCAL SYSTEMS)

MEANS OF	1:RA/CN	1:RA/RCH	CN/CH	CV/CH
MAX	0.8140	0.9390	0.9430	0.9150
MEAN	0.6180	0.7170	0.6610	0.5250
MIN	0.2000	0.2890	0.3000	0.2230
ST.DEV.	0.1550	0.1550	0.1870	0.1410
r : K	-.4697	-.3950	-.3430	-.2935
r: log K	-.5468	-.3767	-.3703	-.3126
r: log K controlling for mean RRA	-.4612	-.3090	-.1942	-.1101
r:mean RRA	-.5486	-.2944	-.7402	-.7201
r:mean RRA control for logK	-.4637	-.1930	-.7041	-.6877
r:(1:RA/CN)	-	-.1247	-	0.4289
r:(1:RA/CN) control for logK	-	-.4263	-	0.3243
r:(1:RA/CN) control for mean RRA	-	-.3582	-	0.0583

TABLE 3.24: MEANS OF SECOND ORDER MEASURES FOR THE 43 QUARTERS (LOCAL
SYSTEMS) AND CORRELATIONS WITH SIZE AND MEAN INTEGRATION

They indicate that the grid at the level of the quarters presents a much lower mean maximum connectivity, but a little higher integration than the large systems they constitute. On the other hand, the mean integration of the 12 large systems as already pointed out tend to decrease as the towns become bigger (see Table 3.1, p. 167). This suggests that the general trend in these towns as they grow larger, is that they tend to increase, but only a little, their maximum connectivity, while decreasing their level of integration. In other words, there seems to be an increase of connections of very few lines which do not occupy a privileged position in terms of integration in the overall urban grid, but not enough lines as to create a kind of a "super-grid" in order to maintain the same level of integration as the parts. These towns seen as group showed then a tendency to become more globally segregated by developing well connected lines, but which are more or less randomly located in parts of the urban grid that are not integrated. In fact, the situation is more complex than it appears. The town-by-town analysis has shown various ways in which this is realized in the individual cases. This particular point will be further discussed in Chapter Five where an overall review of the analytical results for all towns will be presented. But it remains to say that the analysis of the 12 systems taken as a group has clearly shown distinctive typological properties underlying the grid structure of Arab towns, in contrast to the 75 urban systems of the SERC report, especially with regard to their degree of integration and the relationship of the analytical measures with size. These towns taken as a group showed also a tendency to become less intelligible and develop a lower movement interface, but a stronger relation between intelligibility and interface potential (CV/CH) than their parts.

CONCLUSION AND SUMMARY OF CHAPTER THREE:

This chapter has shown how the urban grid of the 12 Arab towns considered, present in fact individual characteristics that cannot be dismissed or ignored. It has shown strong variations between the towns in the structure of their grid defined by the degree of integration, the level of intelligibility and movement interface; strong variations in the way the grid is deformed in the light of their global structure and the way this relates to the spatial organisation of the parts, and also differences in the relationships of the parts and in the degree to form a super-structure; variations in the way the overall grid structure relates to the town facilities and also differences between the towns in the degree the grid relates to its edges.

Consistent results have emerged from the detailed analyses of the towns, that is: i- the integration cores of the 12 urban systems displayed strong regionalization, that is a confined core to a limited area of the overall urban fabric;

ii- In most towns, the global core follows the overall pattern of the market streets regardless of their geographical location in the urban fabric; iii- the dead-end passages, although segregated in most cases with respect to the overall structure of the grid, have been found to not contribute, nor determine the overall level of segregation observed in Arab towns. In spite of the reputation of the cul-de-sacs in Arab towns as being labyrinthine, it turns out that for the most part they are relatively shallow, and consistently shallow so that they do not decrease the integration of the towns as a whole. The

towns, on the other hand, lack integration (see Table 3.1, p. 167), but this lies in the distributed structure, not the cul-de-sacs. This appears so mainly because the cul-de-sacs seem to be added uniformly throughout the system, that is as many are added to integrated spaces as to segregated ones. This seems to be the same with the improvement in the intelligibility when the cul-de-sacs are added. It seems quite clear why this happens. In adding cul-de-sacs, one is adding spaces that are less integrated on the whole and poorly connected: the first line of the non-distributed lines has two connections, the rest has one connection. So, overall, this would create a "tail" in the scattergram that improves the overall correlation. These results suggest then that there can be two ways of achieving this kind of syntactic intelligibility: the distributed and the non-distributed way.

Further individual properties of the towns will be discussed in the ensuing chapters and an attempt will be made to examine their implications on design. But, this chapter has clearly shown that the urban grid of Arab towns presents distinctive properties by reference to the 75 urban systems as described by the SERC report (UAS, 1986). The spatial analysis of these towns taken as a group has shown a poorly connected and highly segregated spatial fabric, which lacked intelligibility and presented a poor level of movement interface (as determined theoretically), as opposed to the 75 urban systems.

This chapter has also revealed another distinctive characteristic underlying the configurations of these towns which is expressed by a poor relationship between the level of intelligibility of these systems and their movement interface which is neither created by

size nor by integration, and a strong relation between intelligibility and the interface potential. Before discussing these individual and common properties in more details, which will make the main concern of Chapter Five, a more detailed investigation of the relationship of the location of the main town facilities to the global structure of the grid will be undertaken in the subsequent chapter.

CHAPTER FOUR: TOWN CENTRE, KEY TOWN FACILITIES AND THE INTEGRATION MEASURE

The present chapter is concerned with an investigation into the spatial location of the key town facilities -the great mosque and the market area. Chapter One showed how past studies on Arab towns have often stressed the central location of the great mosque and the adjoining markets, as a key characteristic in the physical organisation of these towns. This cannot be held as a typical property of these towns, as Chapters Two and Three have shown a great deal of variation between the towns regarding the location of the great mosque and the market areas. In the light of the spatial measures of integration, choice and journeys presented earlier, the following section aims to look more closely at the spatial location of these two main town facilities and see whether there is a consistent relationship between their positioning and the global configuration of the towns. In this respect, the present chapter begins by briefly examining the concept of urban centrality in general.

The idea of centrality has been used in different contexts and has taken on different forms within city development, from a straightforward idea of modern transport efficiencies to complex symbolism in early societies (i.e., Wheatly P., 1971). In this respect, Wheatly and Eliade argue that the first urban centres were projected images of cosmic order on to the plane of human existence. They maintain that the square, the circle, roads in the form of a cross generate shapes in which the idea of a centre is subtended at a geometric point within them (Wheatly P., 1971, p. 225; Eliade M.,

1949). The first evidence of centrality in urban systems was, according to Bird, the dissociation of religious functions (Bird J., 1977, pp. 32-33). For example, for societies who oppose sacred space to profane space that surrounds it, space cannot be homogeneous and the centre, a fixed point for orientation, becomes the centre of man's religious worlds (i.e., Eliade M., 1960, p. 137; Durkheim E., 1915, p. 422). Wheatly also maintains that in the beginning of urban formation centres are dominated by a ceremonial complex, and that religion provided a primary focus for the earliest urban dwellers. The centre as a symbol of worship can then act as a legal basis of a city continuous proclamation of its own centrality, its *raison d'être*, a reference to the very beginnings (Wheatly P., 1971, p. 225).

Whatever its origin, the concept of centrality always evokes the idea of a non-centre or a "distance-decay" to a periphery. This suggests then a distinction between two "poles" in the overall physical layout of the city, resulting therefore in a kind of spatial variety and ordering (i.e., Bird J., 1977, pp. 1-2). According to Bird two types of centrality can be distinguished on the basis of the process of city formation; that is according to whether the urban system has been perceived and designed in advance or it grew organically over a long period of time. The former refers to a consciously planned reference of centrality on to a chosen location, such that within the plan there is from the beginning, a centre and a periphery. In the latter, instead of a priori centre, there is often an original area and a later area.

The centre/edge dichotomy has been associated by many writers with the notion of "territoriality and identity" (i.e., Darling F.F., 1962; Ardrey R., 1966). In these terms, a territory centre is something

perceived by the individual in response to an inner orientation; but for social groups who have a strong image about the areas their group occupies, the "centre" which all social groups use at one time or another, becomes in this framework, a social place par excellence where first of all, awareness of others can be at its maximum. In fact, what is argued is mainly the universality of the notion of centrality which underlines some general similarities between urban systems. That is, the emphasis of research is mainly oriented a priori towards the search for similarities and constant factors between urban forms.

Throughout urban history, different reasons were invoked for centre genesis. For instance, Mumford suggests the palace and the temple as the main foci in a city (Mumford L., 1961, p. 34), although later he seems to put the main emphasis on religion (Ibid, 1962, pp. 14-16). For Arab towns, the religious building -the great mosque- is seen as the first building project to be undertaken when founding a new town (Hakim B., 1986, p. 67; Levi-Provencal, 1948, vol.i, pp.19-20). For this purpose, a site in the geographical centre of the new settlement is allocated, and many activities weld and develop around the great mosque. Bianca also describes the town centre as the core which lies in the link between the great mosque and the market, a link which rests according to Bianca, on an ancient Arab Islamic tradition, since Makkah was already at one and the same time a place of pilgrimage and a commercial centre (Bianca S., 1975, p. 68).

In modern city planning, it is accepted that a daily attraction to a town centre of a maximum number of users, reveals a successful locational choice, which is also valued in terms of the degree of

accessibility it presents. Distance criterion appears as one essential factor in the decision-making on the location of a town centre (i.e., Keeble L., 1964, p. 169) and as such explicitly calls for a certain geometrical centrality. By contrast, in the so-called organic towns such as the towns of interest, town centres with the great mosque and the market areas -the two main structuring elements commonly known as places, par excellence, of intense use and constant daily liveliness, are located regardless to any apparent geometrical order. Bird argues that the interactions between spatial forms and human objectives which lies at the centre of city planning work, shows that, when man projects his desired world with its centres and non-centres on the perceived world and then organises the latter in an effort to gain the former, the elements of this association would be differently arranged in different cultures or operated with different intensity, but the basic method always operates, giving a cross-cultural regularity (Bird J., 1977, p. 26).

The allocation of distinct sites to major public facilities in the urban fabric generated ambiguities in defining the limits of town centre and its centrality. The problem is less related to terminology, as the difficulty is often overcome via function (i.e., religious centre, administrative centre, commercial centre...), but concerns more the methods employed in central city measurement. There have been many attempts to measure objectively some qualified form of centrality, and each approach takes into consideration different parameters. The Murphy-Vance method, for instance, which takes into account value of trade, building heights, block shape and size, traffic flow, pedestrian counts and land valuation, is concerned with centrality not

geometrically measured, but deriving from peak of accessibility as the chief focus of transport (Murphy R. E.; Vance J. E., 1954, pp. 189-222). Murphy had himself reflected on the limitations of the method he advocated, notably the distinction between central and non-central uses which remains subjective (Murphy R.E., 1972, p. 98). These attempts may have indeed, measured some form of "relative centrality", but a certain degree of subjective assessment, particularly with regard to the classification of central and non-central uses, or block shape and size which vary from one city to the other, remained difficult to avoid.

Herbert also attempted to measure "centrality", referred to by Bird as "internal centrality", on the basis of a rate index where gross rateable values are divided by units of ground floor; and the higher values, the more central the establishment within the centre (Herbert D.T., 1961, pp. 273-292). Campbell, on the other hand, has used an "index of relative centrality" derived from graph theory in order to assess the functional centrality of industries (Campbell J., 1972, pp. 79-87). Stanley has also produced a formula (*) to calculate "centrality" based on the road connectivity, using graph theory (Stanley W. R., 1970, pp. 545-6), in which the centrality of a town is an expression of its "centralness" to the entire road network.

It might be suggested that ideas about urban centrality fall into two broad types: the representational and the empirical. In a sense

(*) In Stanley's formula, if a road network is converted into nodes and edges, then a Koining number may be calculated as an index of centrality for each node: the lower the Koining number for each node, the greater the centrality.

therefore, the measure of "relative asymmetry" (Hillier B., Hanson J., 1984, pp. 108-109) introduced in the preceding chapter is geared towards the resolution of some aspects of this dichotomy. As discussed in Chapter Three, the relative asymmetry measure (RRA) expresses the degree to which a given space is integrated or segregated with respect to the whole system to which it belongs. As such, this measure is globally biased and provides what might be described as a "centrality index" for all spaces of a system. The measure is thus both empirically derived, but also arrives, through the concept of "integration core", at a global concept of urban form which in some sense also "represents" the urban pattern.

The following sections will therefore consider the position of the great mosque and the market streets, commonly acknowledged as the key structuring elements of the town centre in the towns under study, mainly on the basis of the integration measure, and see whether there is a consistent relation between the geographical location of these two key facilities and their degree of integration. In other words, the following sections will examine the degree to which the integration core may co-incide with the idea of a town centre defined according to the location of the main town facilities.

THE GREAT MOSQUE AND THE SYNTACTIC MEASURES

A visual examination of the ground plans of the 12 towns showed that the great mosque does not always occupy the geographical centre of the towns. Clearly, its location varies greatly from one town to another. It is centrally located only in 3 out of 12 towns (Fez, Tunis

and Wargla) and in 5 towns, it is found on the edges (Kairwan, Algiers, Susa and Tangier).

However, a visual comparison of the location of the great mosque in the towns under consideration and the pattern of distribution of integration appears to suggest some relation between the spatial location of the major religious building, the great mosque, and the degree of integration of the spaces adjoining it. Table 4.1 shows the integration value (top line) of the most integrated line adjoining the great mosque, in each of the 12 towns analysed without and with the dead-end passages (V.1 and V.2), and also with the peripheral lines omitted (V.3). In the table, the value between brackets indicates the maximum integration value of the system and provides a reference point. The top line corresponds to the integration value of the selected line, whereas the bottom line corresponds to the order of integration of the selected line. When the great mosque is found along the 50% most segregated lines of the system, this is indicated in the table by the notation "SEG"; whereas when the mosque is outside the 10% most integrated spaces or the 50% most segregated, it is indicated by the notation "MED" (i.e. medium). In the choice and journey table, the gap "-" refers to the fact that the great mosque does not figure on the strong choice lines, representing 25% of the total choice quantities, or on the strong journey paths.

Table 4.2 then shows the extent to which the spaces adjoining the mosque, figure on the choice lines and the lines given by the random journeys from the outside. Similar tables (4.3 and 4.4) have been set up for the market streets and these will be discussed below. For both, the market and the great mosque, the effect of some morphological

features of the urban fabric, such as the dead-end passages (V.2) and the town's edges (V.3) will be also tested.

Table 4.1 (see below) shows:

-In the distributed systems (V.1), the great mosque figures on the most integrated space in 2 cases out of 12: Tunis and Wargla; but in three cases (two of which correspond to the sectarian religious communities of Guemar and Tamelhat), it forms part of the 50 % most segregated spaces. But, in 9 out of 12 cases, the spaces adjoining the great mosque form part of the integration core, although their order of integration varies greatly from 3 to 33. When the towns are taken with the dead-end passages (V.2), the great mosque remains as previously only in two cases (Tunis and Wargla) along the best integrator, and along segregated spaces in three cases. But, the order of integration of the great mosque varies strongly in each of the remaining cases (except for Susa), improving in some towns (i.e., Algiers, Meknes) and worsening in others (i.e., Tangier and Constantine). However, the great mosque remains within the integration core in 8 cases out of 11, indicating therefore that the integration of the great mosque does not seem to be affected by the presence of the dead-end passages in the grid structure of the towns.

	V.1	V.2	V.3	LOCATION
<u>TUNIS</u>	0.8853 (0.8853) 1	0.8880 (0.8880) 1	0.9274 (0.9274) 1	central
<u>ALGIERS</u>	1.3496 (1.2077) 33	1.2593 (1.1746) 20	1.3573 1.2204 41	peripheral
<u>SUSA</u>	(0.9051) (0.8581) 9	(0.9016) (0.8693) 6	(1.0358) (0.9200) 10	peripheral
<u>SALE</u>	SEG.	SEG.	SEG.	internal, not central
<u>TANGIER</u>	1.2434 (1.2178) 3	1.2307 (1.1094) 24	(1*)	peripheral
<u>FEZ</u> (2*)	1.5584 (1.2178) 10	(1.3441) (1.2384) 16		central
<u>MEKNES</u>	1.1044 (1.0274) 18	1.0252 (0.9454) 5	1.1668 (1.0592) 22	internal, but not central
<u>CONST- ANTINE</u>	1.5038 (1.3558) 7	1.4347 (1.2786) 37	1.5017 1.3647 7	internal, but not central
<u>KAIRWAN</u>	(1.0498) (0.9849) 10	0.9697 (0.9065) 13	SEG	peripheral
<u>WARGLA</u>	0.6960 (0.6960) 1	0.6689 (0.6689) 1	0.6984 (0.6984) 1	central
<u>GUEMAR</u>	SEG.	SEG.	SEG.	internal, not central
<u>TAMELHAT</u>	SEG	SEG	SEG	internal, not central

TABLE 4.1: INTEGRATION MEASURE OF THE MOSQUE FOR THE 12 TOWNS

(*) Version V.3 does not exist for Fez and Tangier (see Chapter Three).
 (2*) As already mentioned in Chapter Two, Fez has two main mosques on either banks; but the figures in the tables refer to the largest of the two and also the most important in the town (El-Quarawyyin).

When the towns are considered without the peripheral streets (V.3), the great mosque appears again in the same two towns of Tunis and Wargla, on the most integrated space; but in four cases on segregated spaces, and for the remaining cases, there is a clear drop in the level of integration of the mosque. For example, in Kairwan the great mosque becomes segregated when the system is looked at without the peripheral streets. From this, it appears that when the peripheral streets are discounted, there is a loss in the level of integration of the mosque within the overall system, and only in 6 cases out of 10, the mosque remains part of the integration core, suggesting thus that in some towns especially those where the mosque is located at the periphery, the integration of the great mosque within the overall structure is to a certain extent, governed by the connections of the towns to its periphery.

Turning to the measures of choice and journey paths in Table 4.2, it can be said that the great mosque of Tunis and Wargla, which appeared on the best integrator in all versions, is also on the strongest choice spaces, but not on the best spaces in the random journeys from the outside. It is only in 6 out of 12 towns that the great mosque figures on a strong choice line regardless of its geographical location. It is also only in 6 out of 12 towns where it figures on random journey paths, in four of which the mosque is peripheral. However in the case of Fez, the second main mosque located on the eastern bank of the town, does appear on the journey paths (14th). Therefore and in contrast to integration, the great mosque emerged on both strong choice and journey spaces only in few cases (6 out of 12 towns), in two of which the mosque is centrally located and in the remaining three, it is on the periphery (Susa, Kairwan and Tangier).

	CHOICE	JOURNEY	LOCATION
	V.1	V.1	
TUNIS	2	15	central
ALGIERS	-	7	peripheral
SUSA	5	5	peripheral
SALE	-	-	internal, but not central
TANGIER	4	6	peripheral
MEKNES	-	-	internal, but not central
FEZ	-	-	central
CONSTANTINE	10	-	internal, but not central
KAIRWAN	2	4	peripheral
WARGLA	1	10	central
GUEMAR	-	-	internal, but not central
TAMELHAT	-	-	internal, but not central

TABLE 4.2: THE GREAT MOSQUE AND THE CHOICE AND JOURNEY PATHS

THE MARKET AREA AND THE INTEGRATION:

One of the important outcome of the previous chapter, is the striking similarity observed between the overall pattern of the market streets and the shape of the integration core, with the exception of Guemar. This strong correspondence is further expressed when looking at the order of integration of the lines of the core. Table 4.3 (see below) shows then the integration value (top line) of only the most integrated line found along one of the market streets shown in the axial diagrams in Chapter Three, in each of the 12 towns and according to the three versions.

In V.1, at least one street of the main market area emerges as the best integrator in 10 cases out of 12; it is segregated only in Guemar. In Algiers, although the market is 7th in terms of integration, this remains very close to the maximum integration. The integration value brings the number of towns where the market street is strongly integrated to 11 cases out of 12. When the dead-ends are considered (V.2), the market remains as the best integrator except for Guemar, where the market is no longer segregated, but still outside the integration core. In Algiers, the integration of the market becomes 1st when the peripheral streets are discounted, and in 7 out of 10 cases a market street still comes out as the best integrator. With the exception of Guemar, the market street in the remaining cases is among the first four most integrated spaces. This suggests that the strong integration of the market is in a large measure, not dependent on the connection of the towns to the periphery.

	V.1	V.2	V.3
<u>TUNIS</u>	0.8953 (0.8953) 1	0.8880 (0.8880) 1	0.9274 (0.9274) 1
<u>ALGIERS</u>	1.2600 (1.2077) 7	1.1746 (1.1746) 1	1.2662 (1.2204) 4
<u>SUSA</u>	0.8581 (0.8581) 1	0.8693 (0.8693) 1	0.9200 (0.9200) 1
<u>SALE</u>	0.7785 (0.7785) 1	0.7079 (0.7079) 1	0.7788 (0.7788) 1
<u>TANGIER</u>	1.2178 (1.2178) 1	1.2079 (1.1094) 1	
<u>FEZ</u>	1.5370 (1.5002) 1	1.2384 (1.2384) 1	
<u>MEKNES</u>	1.0274 (1.0274) 1	0.9454 (0.9454) 1	1.0834 (1.0592) 3
<u>CONSTANT.</u>	1.3558 (1.3558) 1	1.2786 (1.2786) 1	1.3647 (1.3647) 1
<u>KAIRWAN</u>	0.9849 (0.9849) 1	0.9065 (0.9065) 1	1.0700 (1.070) 1
<u>WARGLA</u>	0.6960 (0.6960) 1	0.6689 (0.6689) 1	0.6984 (0.6984) 1
<u>GUEMAR</u>	SEG.	MED	SEG.
<u>JAMELHAT</u>	0.5163 (0.5163) 1	0.5573 (0.5573) 1	0.5800 (0.580) 1

TABLE 4.3: INTEGRATION OF THE MARKET STREETS IN THE 12 TOWNS

Table 4.4 shows that the results for choice follow a similar pattern to those for integration. In 8 towns out of 12, a market street is on the strongest choice line, and in all other cases except for Guemar, a market street emerges as a strong choice space. On the other hand, it is only in Sale and Tameihat that the market emerges on the best line in the random journeys from the outside, although in most other cases, the market is within the dominant journey route from the outside (11 cases out of 12).

	CHOICE (V.1)	JOURNEY (V.1)
TUNIS	2	19
ALGIERS	8	4
SUSA	4	11
SALE	1	11
TANGIER	1	7
FEZ	1	20
MEKNES	1	12
CONSTAN.	1	9
KAIRWAN	3	5
WARGLA	1	10
GUEMAR	-	-
TAMEIHAT	1	1

TABLE 4.4: THE MARKET STREET AND THE CHOICE AND JOURNEY PATHS FOR THE 12 TOWNS.

Despite the variation in the geographical location of the two key town facilities within the fabric, the above tables point to the conclusions that first, the results regarding the market streets are of a much

greater significance than the outcome of the analysis of the great mosque location. Second, a strong relationship seems to exist between the spatial location of the market and the overall grid structure of the towns, both in terms of integration and choice properties. However, the relation of the location of the market streets appears much stronger with the integration than with the measure of choice, and to a lesser degree with the random journeys from the outside. At least one market street emerged in almost all cases and according to the various analyses, as the most important element in terms of "internal" integration. At least one market street also emerged as part of the choice structure and on the dominant journey paths from the outside. As a result, the strong integration of the market reinforces its role as an element of a primary global importance. Third, the spatial location of the great mosque, although varying greatly from one town to another, suggested great variation in terms of integration. Fourth, the conceptual nature of the integration measure and choice also suggests that a "natural" interface between the inhabitants and the strangers, is then likely to take place in this case at the market area, regardless of its geographical location in the townscape. Centrality as defined syntactically as a practical concept, is about organising movements and interfaces, which goes against the view adopted in the literature on Arab towns, where the emphasis is placed upon the representative centrality of a religious symbol.

Therefore, the close correspondence between the location of the town centre (especially the market streets) and the urban core corroborates the concept of centrality measured on the basis of the integration (Hillier B., Hanson J., 1984, pp. 108-109). This suggests that the degree of integration of the urban core in these "unplanned" towns, can

be valued in terms of route complexity expressed in terms of changes of direction.

These results are strong, but not uniform evidence to conclude that the location of the main public facilities in these towns is not based on geographical centrality, nor on geometrical order, but is much more related with the global structure of the towns and to the nature of the urban grid. This result is all the more striking in view of the fact that the 12 integration cores of the towns under study reveal not only variations between the cores in terms of their overall shape, but also clear differences with respect to their location in the overall urban fabric. This point will be discussed in more details in the ensuing chapter, but here it can be briefly said that there are urban cores which develop in the middle of the towns linking opposite town edges, such as the core of Tunis; or in the peripheral areas such as the core of Susa; there are also urban cores which form a dense cluster in the central part of the town, such as the core of Fez, or a large ring such as the core of Tangier or Algiers. Yet, despite these variations in the structuring of the urban core, the market streets have, except for one case, been globally integrated, that is on the town integration core. The most pertinent question that follows is then: what are the spatial means used in these towns to achieve and maintain the high integration of the main town facilities such as the market area?

The examination of the ground plans and axial maps of the towns indicates three possible spatial means: i- the increase in the axuality of some streets in the market area; ii- the increase in the convexity of some spaces (market square) and the axuality of some converging streets; iii- the increase of the connections of some streets in the

market area. The introduction of these spatial properties suggests then an introduction of some globalizing rules on the growing systems, and therefore an investment of more order particularly in the area of the market.

SUMMARY OF CHAPTER FOUR:

The brief review of literature in this chapter showed two views of urban "centrality": one representational, the other practical or empirical. The syntactic concept of "centrality" as defined through integration has elements of both: it is an empirically derived measure and is about how towns work instrumentally; but also arrives at a global concept of the town which relates to its overall form.

The application of the syntactic measures to the location of the great mosque and markets showed different results in the towns of interest. For the market streets, the results are remarkable in two ways: first, the shape and location of the market street system, in spite of its great variations from one town to the next, approximates almost invariably the overall pattern of the integration core. Second, the numerical results about the most integrating line reinforces this. The results for the mosque are much less consistent. The market results are therefore a regularity; while the mosque results have more idiosyncrasies.

CHAPTER FIVE: GENERIC SIMILARITIES, TYPOLOGICAL DIFFERENCES AND INDIVIDUAL PROPERTIES IN ARAB TOWNS

Chapter One has shown the conventional view which stresses the idea of a single city form underlying the spatial structure of Arab towns. The spatial analysis of the 12 Arab towns under consideration, on the other hand, strongly suggested the existence of substantial variations in their grid structure, but also some common underlying properties.

The present chapter aims in the light of the analytical results to identify the generic features and the morphological individualities of these towns, and also examine the possible existence of typological tendencies. The chapter will then make an attempt to define the socio-spatial character of the grid structure of Arab towns as a general explanation to the typological tendencies, using concepts set up in the "Social Logic of Space" (Hillier B., Hanson J., 1984). This will be done by looking at the possible social dimensions of the prevailing spatial properties; that is the possible implications of the structure of the grid on the patterns of movements of users, by differentiating between the more permanent users, the inhabitants who may be assumed to have a reasonably full knowledge of the system, and the strangers who will know it less fully; and by this conjecture about the type of interface that is likely to take place between these two basic categories of users of these towns. These interpretations must of course remain theoretical and can only be speculative until they are tested by real observations of movement patterns in these towns.

The present chapter will therefore show the limitations of the idea of the predominant role of environmental or simple functional factors in the determination of the grid structure of Arab towns. Chapter Five ends by formulating the question to be broached in the epilogue which aims to look at the extent to which urban design can benefit from morphological and analytical studies of existing forms.

The spatial description of the grid structure of Arab towns has yielded some conclusive results which indicate that there are clearly generic similarities, typological differences and individual properties in Arab towns. The results have shown that:

There are features which Arab towns have in common, and which make them generically unlike other urban systems:

i- The urban grid of Arab towns can be characterized by a markedly lower degree of axial integration on average than the general run of towns. That is, a relatively large number of intervening spaces involving changes of direction, need to be crossed when moving from one area of the town to another, a phenomenon likely to affect mobility and exchange in general. This lower level of integration does not arise from the cul-de-sacs, but from the structure of the distributed circulation system. The cul-de-sacs are in the main relatively shallow, and their addition to the map does not add segregation to the overall structure. One general conclusion follows, that is: the cul-de-sac passages cannot account for the distinctive characteristics of the grid structure of these towns.

The lower level of integration of the distributed grid arises from and strongly depends on a lower level of axial connectivity, and also gives rise to a lower level of axial intelligibility. In all these features, the Arab towns studied are much weaker than the 75 urban systems. Since the syntax theory suggests that the strength of these properties in towns in general is to do with the tendency of urban systems to evolve their global structure under the predominant influence of the inhabitants-strangers interface, then it follows that something else must be happening in Arab towns.

What this "something else" is may be hinted at by the analysis of the inter-relations among syntactic variables. In the 75 systems, there is a strong relation between connectivity and integration (1:RA/CN), a fairly strong relation between integration and intelligibility, and a stronger relation between intelligibility and movement interface (i.e. the theoretical probabilistic interface between inhabitants and strangers) than between intelligibility and interface potential (i.e., the theoretical interface between localized and globalized inhabitant movements). In this (admittedly small) sample of Arab towns, there is a weaker relation between connectivity and integration (1:RA/CN), a stronger relation between integration and intelligibility, a non-existent relation between intelligibility and movement interface, but a strong relation between intelligibility and interface potential. These relations are suggestive and indicative that, at the very least, the concept of hierarchy which often served to describe the grid structure of Arab towns is too generalized for characterizing the urban fabric of these towns. Their lack of integration needs a more careful description and exegesis;

ii- The urban grids of Arab towns show also a marked tendency for the integration core to be strongly regionalized in the plan, and not to be covering (i.e., to get into most areas of the plan to some degree) as is usually the case with European towns. None of the 12 urban cores produced a structure which extends and covers the whole fabric or approaches the "deformed-wheel" core type as defined by Hillier (SERC Report, 1986, pp. 16-17). Instead, the cores however varying in shape and location, were confined to a specific region of the towns.

iii- These strongly regionalized integration cores showed a tendency to strongly correlate with the market areas, but much less with the mosque. This result tends to support the hypothesis of a split between the public and residential parts of the towns; but the fundamental differences in how the core is regionalized suggest that much clarification of this phenomenon is required.

This is the picture which prevails when these towns are looked at as a group. But, the "town-by-town" analysis in Chapter Three revealed a more complex situation with important typological variations between these towns, both in terms of their numerical properties shown in Table 5.1 and their global structures. These may be summarized as follows.

There are strong typological differences to be found at the level of the urban fabric. Certain salient characteristic can be described by visual inspection of the black-on-white plans. The key visual feature seems to be the degree to which a global organisation or super-grid appears to be imposed on the plan. When this is done, there appear to

be four types: the strong global grid type (Guemar, Tamelhat); the stronger (but overall) super-grid type (Tunis, Sale, Susa, Wargla); the weaker (more localized) super-grid type (Meknes, Kairwan, Constantine); and those in which the super-grid seems to be virtually absent (Algiers, Tangier, Fez). These four types correlate strongly with the degree of syntactic integration, with the exception of Constantine.

These strong differences in the level of integration suggest then that there seem to be integration types. The examination of the general data table in the following page, indicates a strong (although imperfect) tendency of the towns to form groups according to the structure of the town grids seen in terms of their degree of integration (see Table 5.1). For instance, the comparison of the integration measures of the 12 towns according to the mean integration of the 12 towns taken as a group, suggests at least three grid types. Tamelhat and Guemar with a much higher integration constitute the first category (C.1). The second category, referred to by C.2 in the table, includes the town grids that have a better level of integration than the mean of the 12 systems; the third category (C.3) of towns are those with a mean integration lower than the mean of the 12 systems taken as a group.

The examination of the numerical properties showed also that there are strong typological differences in the way the towns achieve their overall form. The analysis of the relation of the towns to both their edges and parts (when quarter analysis has been possible) has shown variation in the degree of difference in integration. For example in Tunis, the connectivity (mean and maximum) does not vary markedly

CATEGORY ONE			CATEGORY TWO					CATEGORY THREE						
	TAMELHAT	GUEMAR	WARGLA	SALE	SUSA	TUNIS	KAIRWAN	MEKNES	ALGIERS	TANGIER	CONSTAN.	FEZ	MEAN	
K (V 1)	58	59	256	355	255	628	271	267	505	314	399	723	341	
	(V.2) 72	76	437	579	377	986	492	532	752	506	550	1590	579	
	(V.3) 53	51	239	322	237	605	243	258	443	-	372	-	282	
MEAN CN	3 483	2.712	3.242	3.347	3.192	3.348	3 107	3.026	3.097	2.752	2.842	2.775	3.076	
	3.194	2 605	2.865	2.877	2 812	2 998	2.793	2 643	2.891	2.652	2.687	2 547	2.797	
	2.906	2.431	3.138	3.068	2 911	3 266	2.963	2 977	3.029	-	2.699	-	2 939	
MAX CN	11	5	12	10	10	9	8	9	10	10	8	10	9 333	
	11	6	13	14	10	13	10	10	11	11	9	14	11	
	9	5	12	9	9	9	7	9	10	-	8	-	9.700	
MEAN RRA	0.848	1.061	1.150	1.185	1.272	1.298	1.336	1.416	1.612	1.773	1.897	2 206	1 421	
	0.968	1.063	1.128	1.144	1.307	1.308	1 312	1.393	1.567	1.685	1.810	1 980	1 388	
	1.043	1 383	1 251	1 325	1 508	1 419	1.581	1 491	1 603	-	2.014	-	1.462	
MAX RRA	1.380	1.390	1.681	1.745	1 837	1.780	1.995	2 088	2 300	2.751	2.760	3 739	2.119	
	2.050	1.590	1.810	1.710	1.962	2.216	2 290	2 815	2.180	2.840	2.730	3 638	2 319	
	1.970	2.190	2 020	2.130	2 810	2.170	2.340	2.222	2 257	-	3.180	-	2.328	
MIN RRA	0 520	0.750	0 700	0 779	0 858	0 900	0 985	1.027	1.210	1.218	1 360	1 500	0.982	
	0.560	0 770	0.670	0.710	0.869	0 888	0 910	0 945	1.170	1.110	1.280	1 238	0 838	
	0 580	0.860	0.700	0 780	0 920	0 930	1 070	1.059	1.220	-	1.360	-	0 947	
1 RA/CN (REL)	+ .054	- .005	- .018	- .007	+ .022	- .005	- .082	- 143	- .062	- .205	- .249	- .018	- .059	
	+ .022	+ .047	+ .011	- .037	+ .074	+ .055	- .005	- .046	+ .038	- .112	- .182	- .010	- .012	
	- .024	- .087	- .025	- .073	- .026	- .040	- .193	- .187	- .028	-	- 187	-	- .087	
1 RA/RCH (REL.)	- .199	+ .092	- .032	+ .012	- .083	+ .057	+ .064	- .018	+ .061	- .071	- .135	- .106	- .030	
	- .321	+ .094	+ .035	+ .047	- .051	+ .075	+ .038	- .013	+ .119	- .028	- .089	- .056	+ .049	
	- .227	+ .050	- .069	- .048	- .150	- .037	- 0 47	- .031	+ .067	-	- .173	-	- .077	
CN/CH	0.700	0 810	0 690	0.700	0 630	0 630	0.590	0 610	0.530	0 690	0 500	0 490	0.631	
	0 660	0.820	0.720	0.670	0.640	0.650	0 640	0.680	0.580	0.660	0.570	0.550	0.653	
	0.680	0 720	0.680	0.680	0.560	0 650	0 580	0.620	0 550	-	0.480	-	0.620	
CV/CH	0.740	0 620	0 560	0 530	0 560	0.460	0.430	0.440	0.400	0.520	0.370	0.330	0 496	
	0 710	0.520	0 500	0 430	0.390	0.480	0.410	0 500	0.410	0 350	0.370	0.360	0 452	
	0.650	0 510	0 490	0 400	0 370	0 440	0.350	0 460	0.360	-	0.250	-	0 428	

TABLE 5.1: GENERAL DATA TABLE FOR THE 12 TOWNS (V.1, V.2, V.3 are the other versions of analysis)

with size. But, the parts taken separately appear to have about the same level of integration as that of the whole, indicating then that the town of Tunis while increasing in size, does introduce more structure in order to control the increase of segregation. However, the grid of Tunis connects fairly well to its edges as the removal of the peripheral spaces engenders a clear loss in the integration of the system. In the case of Wargla, there is a substantial increase of the maximum connectivity when the system is taken as a whole, which seems to maintain the same level of integration as its parts, but the integration is not strongly dependent on the connections of the system to the periphery. This is also the case for Sale where the system tends to improve its maximum connectivity when considered as a whole, while retaining about the same level of integration as its parts. The increase of connectivity is partly invested at the periphery, in which case the removal of the peripheral streets results in a substantial drop of the integration of the system. Therefore, the system of Sale seems to overcome the effect of growth by partly increasing its connections to the periphery. This is also the case of Susa and Kairwan, where the connections of the system to the periphery dramatically improves the level of integration of the town.

Unlike Tunis or Sale, the removal of the peripheral spaces led to the conclusion that the system of Algiers does not depend on the connections to the periphery for its integration. Whatever level of integration prevails, it is internal and is not created by the relation of the grid to its edges. In Tangier the street grid presents hardly any connections to its edges. The periphery is marked not by a ring of open space running inside the fortification walls, but by buildings built right against the town walls.

Constantine on the other hand, when considered as a whole, becomes much more segregated than its parts and the connections of the system to the periphery play an important role in creating its level of integration. On the other hand, Meknes and Fez improve the maximum connectivity when taken as a whole, but also become more segregated. In other words, the increase of connectivity does not seem to be effective, and for Meknes it is not confined to the periphery as the removal of the peripheral streets affect only a little the integration of the system.

The above review suggests at least two distinct patterns in the way in which these towns seem to grow and achieve their overall form.

The first pattern is characterized by an increase in the maximum connectivity and a constant mean integration, and includes towns like Tunis, Sale and Wargla which are also more integrated. The second pattern may be characterized by a lesser increase in the maximum connectivity, and also an increase in the level of segregation. This includes towns like Constantine, Meknes and Fez, which are highly segregated. In these cases, the increase of the maximum connectivity clearly does not overcome the effect of size. In the first instance, the results indicate that towns like Tunis and Wargla seem to control their level of segregation by developing strong local lines that tend to interlink to form a global pattern, a kind of a "super-grid" structure. Other towns, like Susa, Kairwan and Guemar develop these strong lines at the periphery; that is, by increasing the connections of the grid to the edges, the systems create large outer "circuits" which tend to control the overall level of segregation.

The towns also showed strong typological differences in the structure of integration core. The examination of the integration cores of the 12 towns taken as a group suggests four types classified according to the location of the core within the overall fabric, the overall shape of the integration core, and the connection of the core to the outside and to the periphery. Within these criteria:

Type one would refer to cores that present a centralized cluster of lines with a diffuse or compressed pattern, and not connected to the outside, such as the cores of Fez and Constantine (see figures 5.1a and 5.1b).

Type two would include cores that present a centralized but linear structure such as the cores of Tunis and Wargla (see fig 5.2).

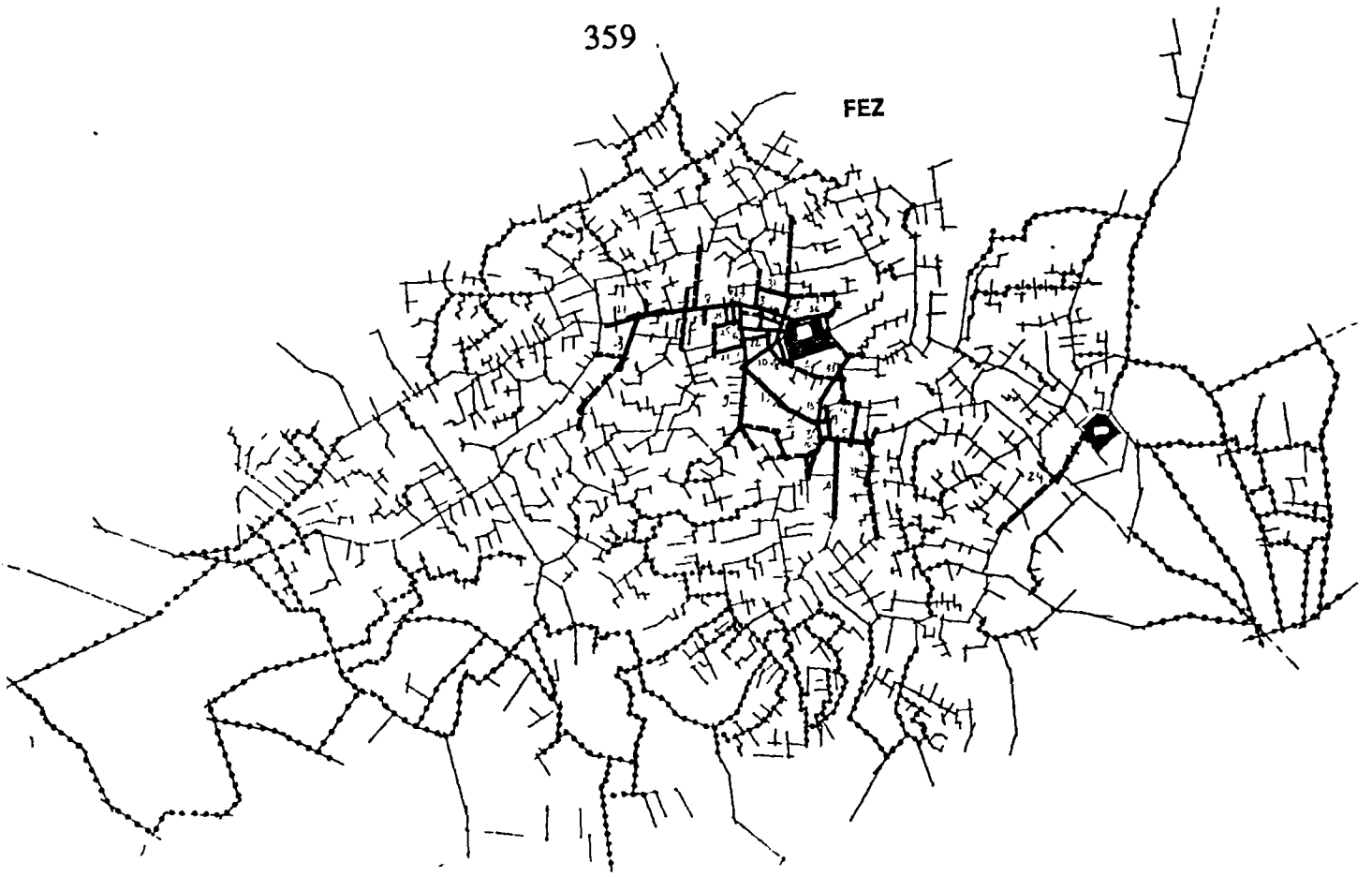
Type three would include cores that present a structure forming either a cluster or a ring of spaces inside the town linked to peripheral spaces and to the outside such as the cores of Kairwan, Meknes, Susa, Tangier, Algiers or Sale (see figures 5.3a and 5.3b).

Type four would include cores that are constituted mainly by spaces that are clustered close to one periphery of the system, such as the core of Guemar or Tamelhat (see fig. 5.4).

As already pointed out, the integration core of Constantine and Fez belong to Type One. In the case of Constantine, the core is more internal without connection to the outside. The predominance of the market streets and the mosque as strong integrating elements

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FEZ



CONSTANTINE

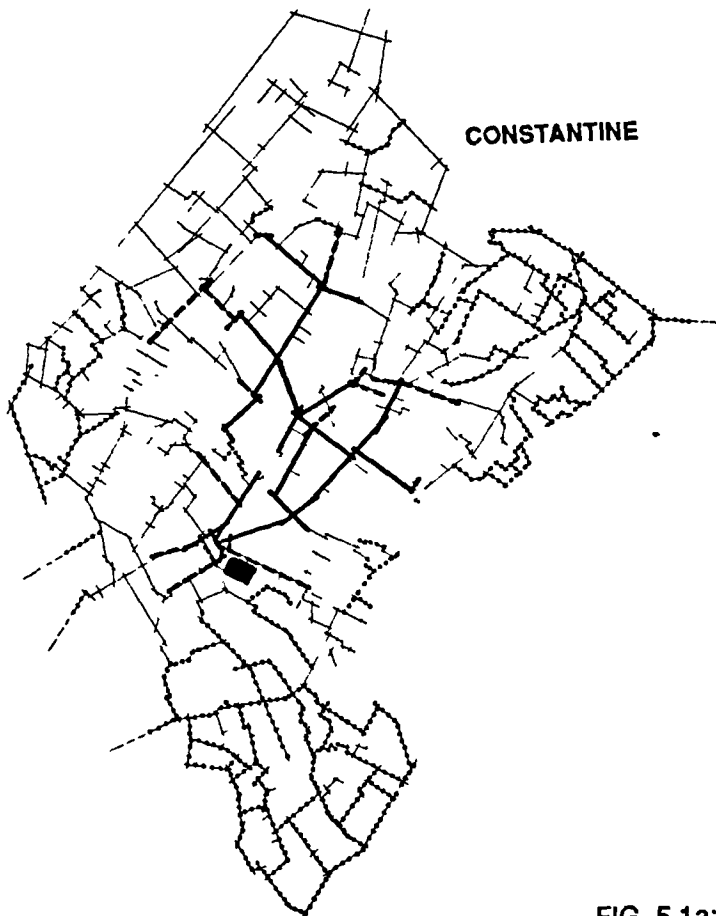


FIG. 5.1a: INTEGRATION CORE
TYPE ONE

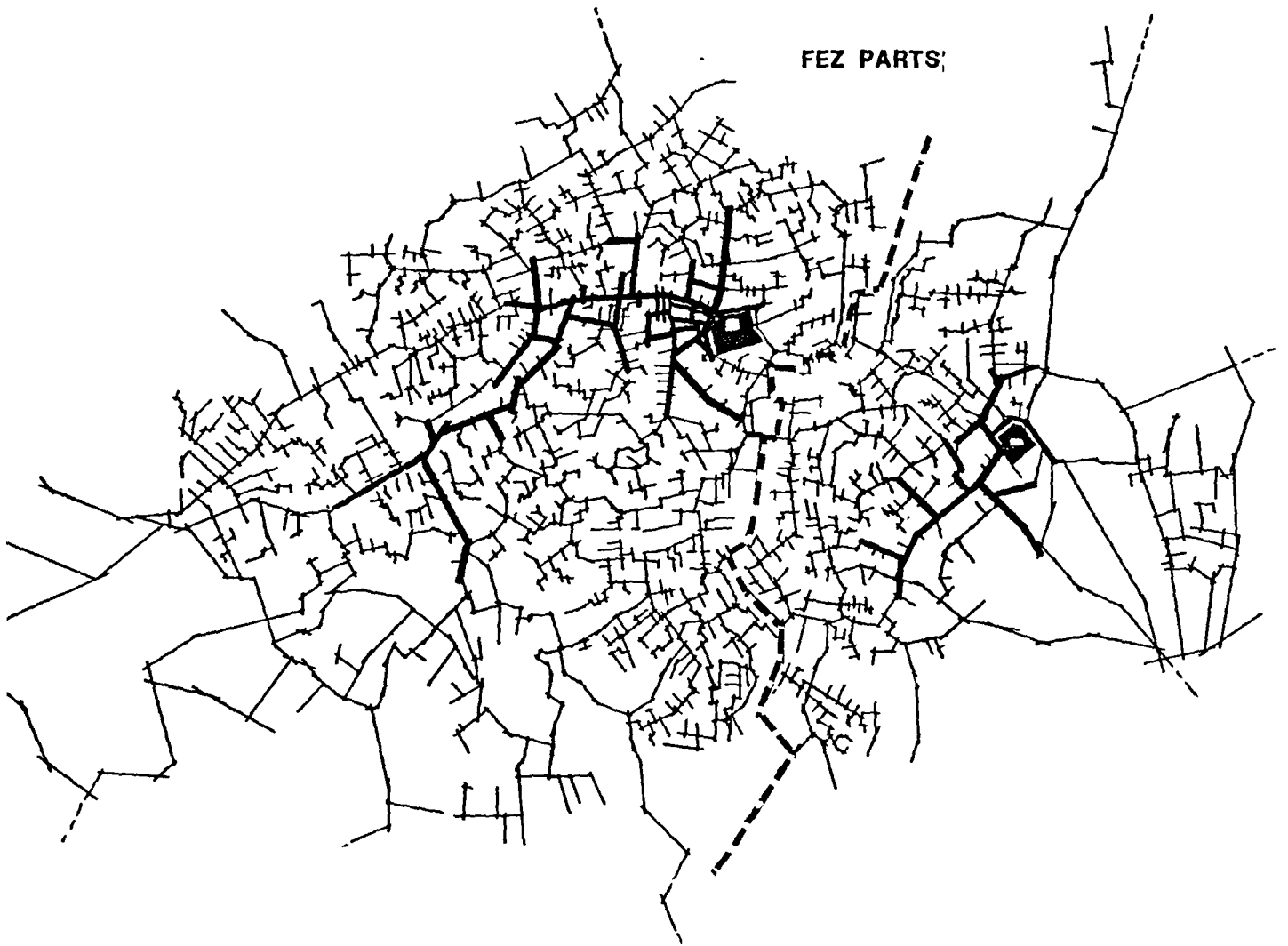
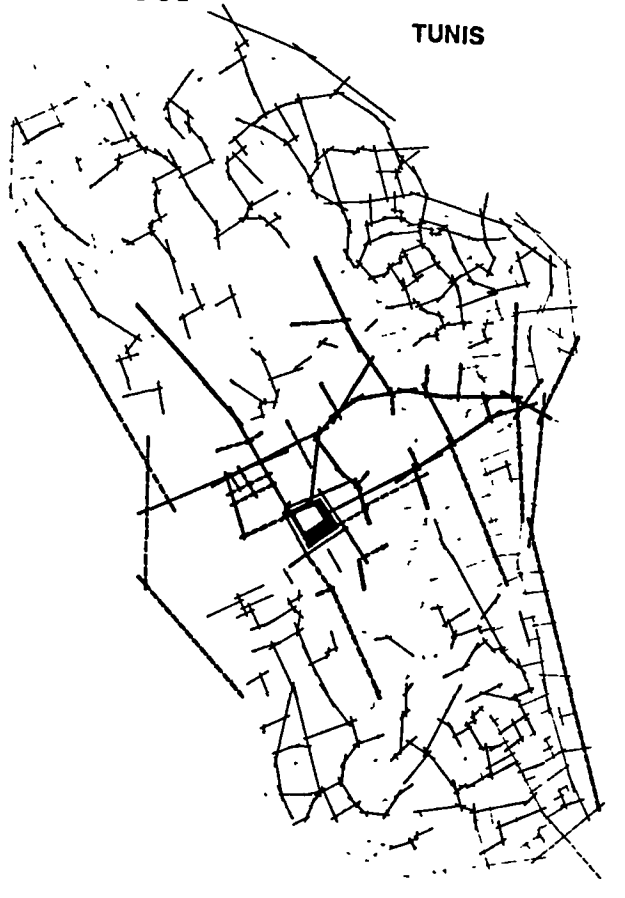


FIG. 5.1b: INTEGRATION CORE
TYPE ONE

TUNIS



WARGLA

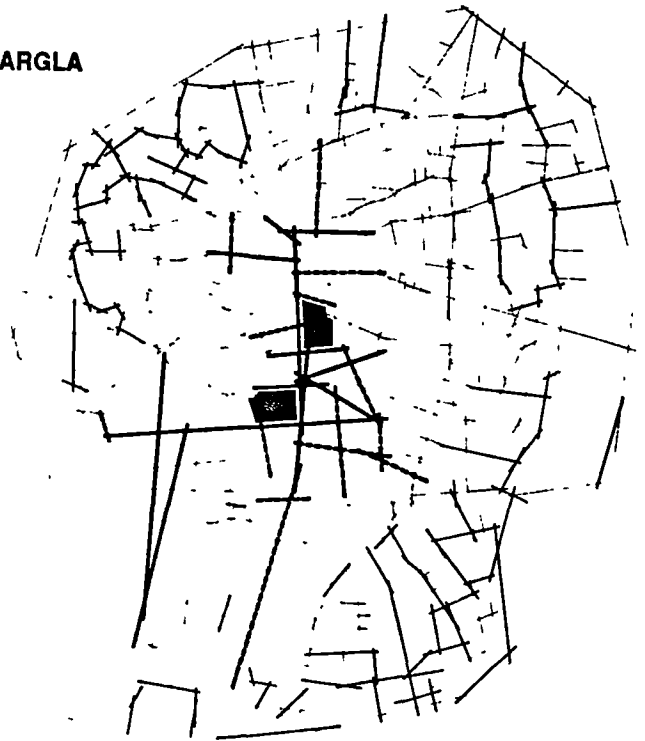


FIG. 5.2: INTEGRATION CORE
TYPE TWO

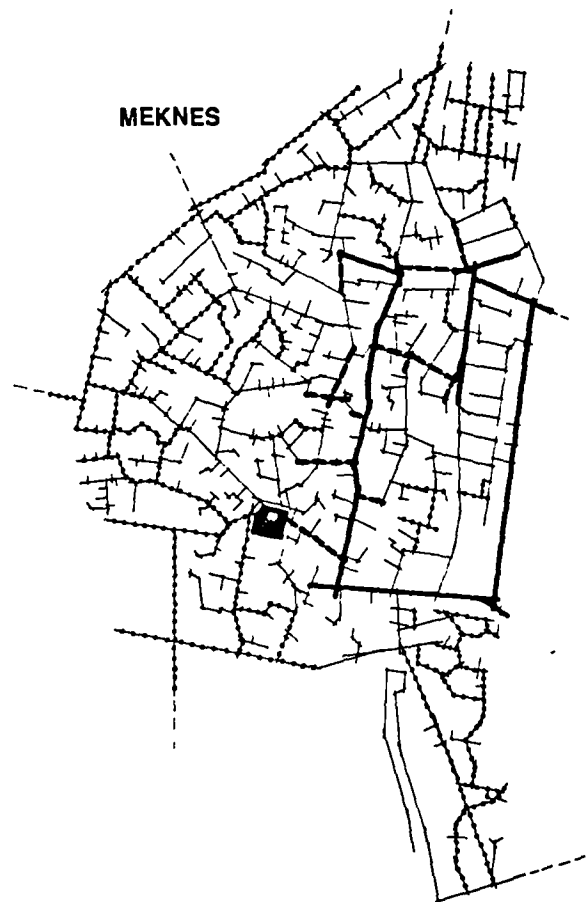
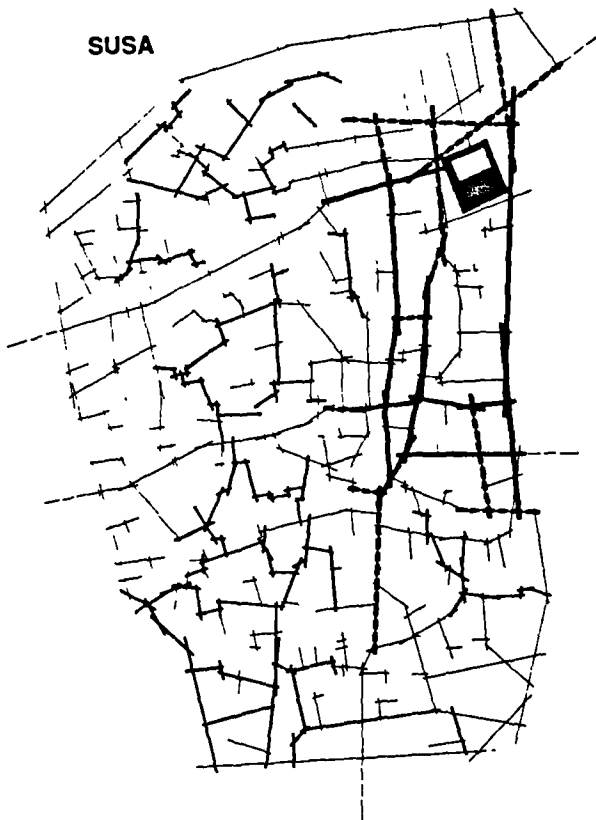
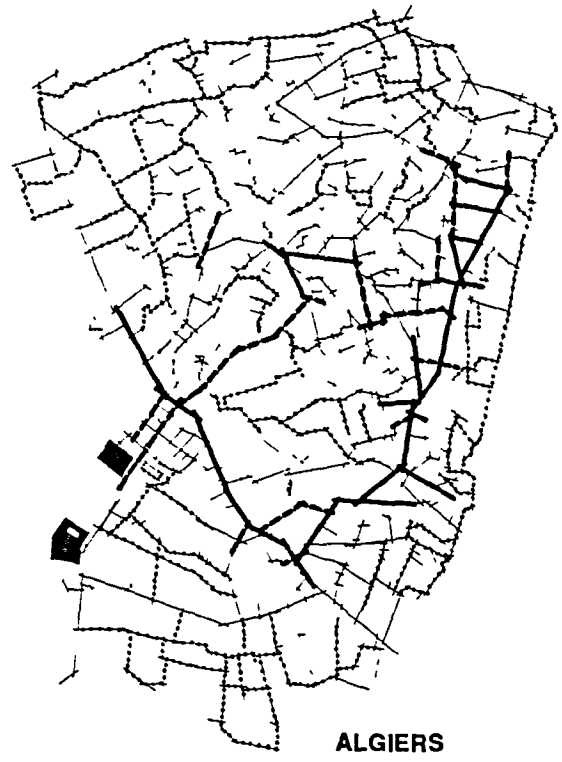
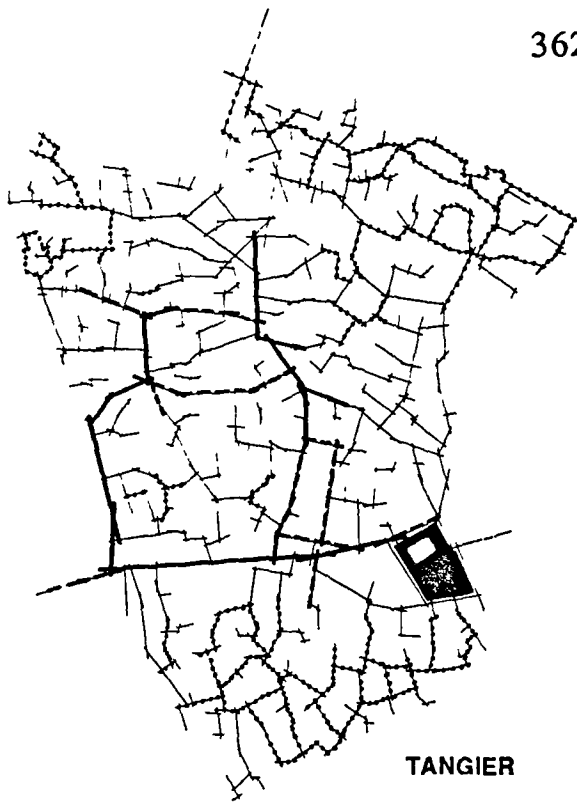


FIG. 5.3a: INTEGRATION CORE
TYPE THREE

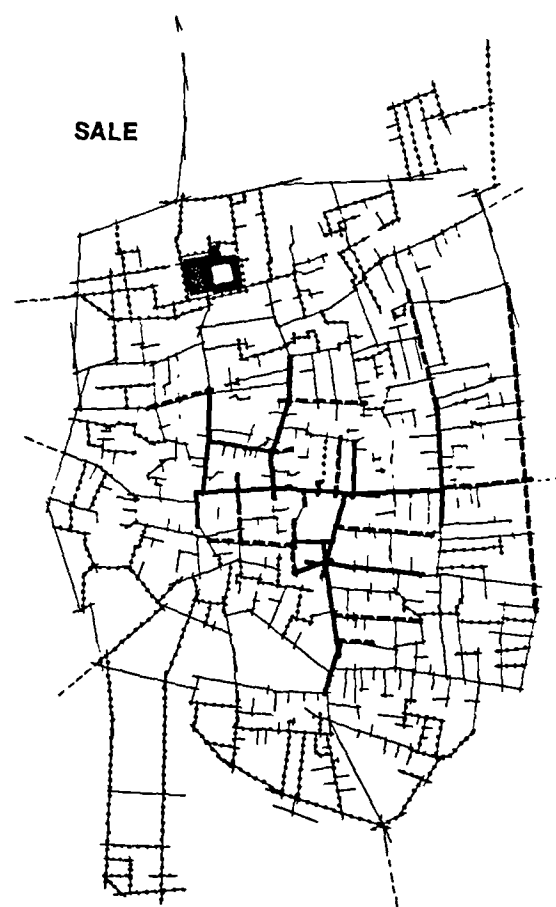
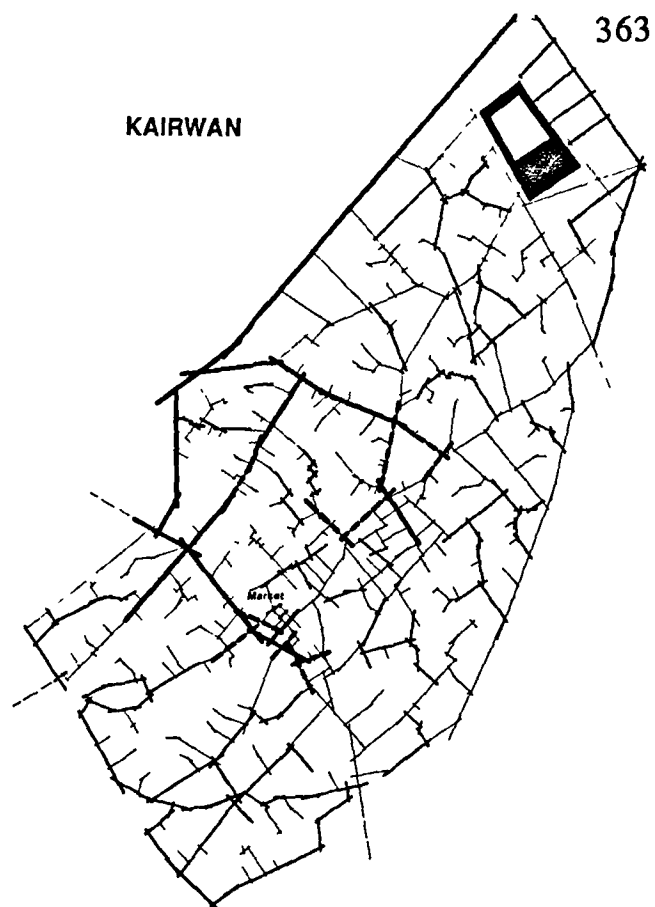


FIG. 5.3b: INTEGRATION CORE
TYPE THREE

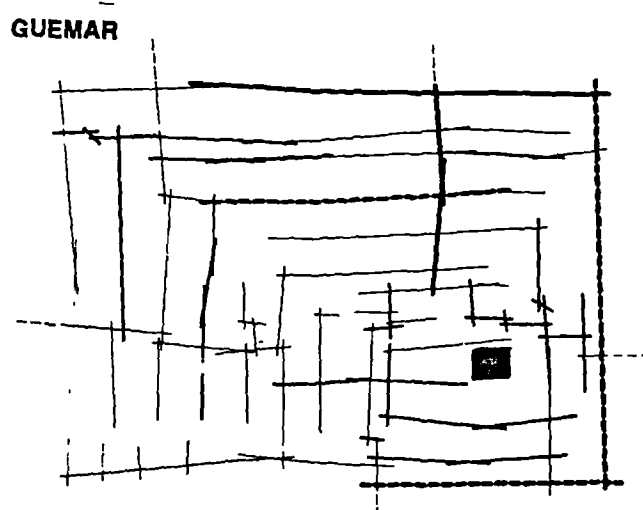
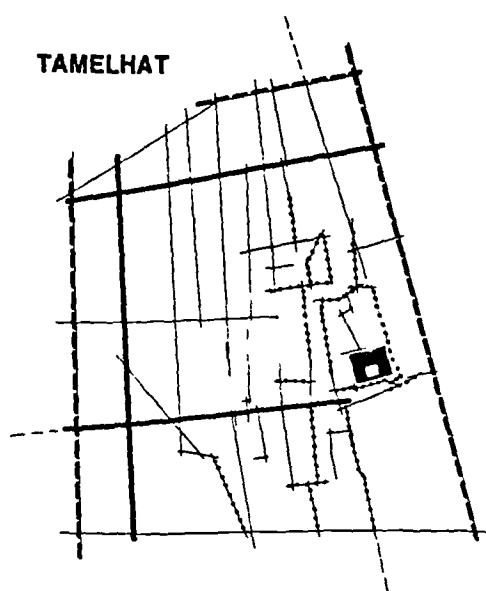


FIG. 5.4: INTEGRATION CORE
TYPE FOUR

prevails in this town. The core of Fez is also internal and is confined to a great extent, to the central part of the town. The two main mosques and several market streets emerge also as the strong spatial elements in the maze-like structure of the grid. Both systems present a mean integration of Category 3, that is a lower integration than the mean of the 12 towns.

The integration core of Tunis classified as Type Two is confined to the central area of the market streets and the great mosque, but is essentially linear linking in two directions to the periphery and to the outside. Similarly to Tunis, the integration core of Wargla as a whole forms a tree-like structure which tends to connect to the outside and on which also figure the main public facilities. The mean integration of both Tunis and Wargla is of Category Two, that is a stronger integration than the mean of the sample.

Half of the towns considered in this study present a Type Three integration core. For Algiers and Tangier, the cores resemble each other in many respects; in that both form a ring in the central area of the system, including the market area. But the core of Tangier, in contrast to Algiers strongly connects to the outside and includes the great mosque. The deep ring structure of the core in these two systems could constitute a separate type of core, in contrast to Susa and Meknes, where the ring formed by the integration core is more peripheral. As a result of the "edge ring" core type, there is a two-sidedness effect in the overall organisation of the town grid, although in Meknes the core tends to run deeper inside the town. In these two towns, the grid is divided into an integrating part and including the mosque and the market streets by contrast to the a

segregated "zone". For Kairwan, the integration core also of Type Three, showed a "bi-polar" structure centred around the market streets and the great mosque. The more regular grid of Sale in contrast to Algiers or Tangier presents also a type core which is confined to the market streets and connects to the outside. The predominance of the market is clearly related to the internal structure of the grid, but the mosque remains highly segregated.

In spite of the regularity of the street system of Guemar and Tamelhat, the integration cores classified as Type Four remain peripheral, and do not include the mosque. In fact, the mosque in these systems is highly segregated. This particular structure of the cores is not the result of the connections of the grid to the peripheral streets, as the removal of these latter does not affect strongly the structure of the cores. Therefore, the geometry of the grid of these towns does not seem to dominate their spatial structure. However, the core of Tamelhat includes the market place in contrast to Guemar where it is segregated. These two towns are also far more integrated than the mean integration of the 12 towns.

Clearly the above review showed at least four types of integration cores in terms of overall pattern, position of the cores in the plan and its relation to the outside. The comparison of the three categories of integration introduced above and the various types of cores produced by the systems under examination, showed strong and suggestive relations between certain core types and categories of integration. This leads to a provisional conclusion that systems with a level of integration of Category One or Two (i.e., an integration higher than the mean of the sample) are more likely to produce a core of Type

Two or Four, that is a core which is either central and elongated. Systems of Category Two can also give cores of Type Three, that is a cluster or a ring of spaces connected either to the peripheral spaces or to the outside, or to both. Whilst, the integration core of Type One, that is central compressed or diffuse and not connecting to the outside, is more likely to be produced by systems with a very low level of integration (Category Three).

The study has also shown strong differences in the degree to which the quarter cores add up into an overall structure which maintains the integration of the then whole at the same level of the parts; and also strong differences in the structure of the radius-3 integration core in terms of its overall pattern and its relation to the quarter cores and to the global core; that is the degree to which the global core corresponds with radius-3 core, and the extent to which it overlaps and links the quarter cores to each other and to the global core. These differences appear to correlate with the typological differences observed from the examination of the black-on-white plans, in the global configuration of the town grids. At least two grid types may be observed in terms of the relationship of the quarter cores: in the first, the quarter cores inter-link and tend to form a globally connected structure; in the second type of town grids, the quarter cores tend to stand apart from each other. In Tunis for example, the structure of the integration cores of the quarters taken separately showed a strong tendency to interlink to form a global structure. This is reinforced by the structure of radius-3 core which also tends to cover the whole fabric and strongly overlap with and link the local cores to each other.

Similarly, the structure of Radius-3 core and quarter cores in Sale, except for one quarter at the south-west corner, tend also to form a connected global structure that links centre to edges in three directions, defining then the three quarters. Despite the differences observed between the town grid of Tunis and Sale, these two systems displayed similar properties in the way the local level of organisation of the parts creates a "super-grid" structure. It is also the case of Wargla where the cores of the three quarters tend to form as in Tunis and Sale, a globally connected pattern. The structure of this pattern is more covering, with a cluster of lines forming a ring in the centre of the town, connecting to the periphery in several directions. The "super-grid" structure created by the local cores and Radius-3 core seems distinctive to all three towns and is far from obvious. This resulting structure leads to the conclusion that the more covering structure formed by the strong local spaces may be seen to contribute in differentiating the local parts and at the same time integrating them by increasing the quarter-quarter interface.

But unlike the three previous cases, the town of Constantine showed through the structure of radius-3 integration core, strong local lines that are highly segregated with respect to the whole system. This is a distinctive feature of this town which suggests that Constantine tends to take a much more localized emphasis as it increases in size; that is, it tends to develop more isolated parts. The local cores of the quarters stand also apart from each other. This is also the case of Meknes or Fez, where the local cores do not show any tendency to link to each other to form a dominant global pattern. The implication of such morphology would be a disjunction of the parts which might

be seen to produce a weaker interface between the inhabitants of the different quarters.

The above review suggest that there are strong typological tendencies in the grid structure of Arab towns, but also there seem to be -at least within the small sample- certain properties which appear more idiosyncratic, most notably the degree of integration of the great mosque. It may be a matter of some surprise that a form of analysis which has revealed strong generic and typological properties for the structure of the urban grid (i.e., the relation of quarters and the relation of the market area to the grid as a whole) should have failed to reveal comparable morphological results for the mosque, especially since this is the most commonly conceived morphological property of the conventional view of the "Arab town". Nevertheless, it seems to be the case. It may be that a larger sample would begin to reveal consistencies and patterns. But, within this sample, it must be recognized that they seem to be absent. The mosque is not, it seems, a fundamental generator of the grid form of Arab towns. More instrumental, less symbolic, yet still fundamentally social attributes are its generators. More specifically, then, one may conclude that within Arab towns, there seem to be a scheme of possibilities with both generic types and typological elements, within which Arab towns become also individuals which combine the typological elements in an idiosyncratic way. A typology cannot encompass their individual variability, any more than the generic properties can exhaust their typology. All these levels of analysis are required to characterize the "Arab town".

Since however, both the generic and typological properties are in

effect distinctive characteristics of Arab towns as a group the question is raised: how can these characteristics be explained, insofar as Arab towns do form a type, and how can they be explained in terms of the observed typological differences within the sample?

The most customary typological explanations of the Arab city and its variants have been based on climatic and functional factors. An attempt will be therefore made in what follows, to test the most obvious explanations, that is the propositions of environmental and functional determination of Arab city form by reviewing the numerical and morphological properties of the towns in the context of their general climatic conditions, the topography of their terrain and the predominant functions.

When these towns are considered from the point of view of climate, they neatly fall into three categories (see Table 3.1, p. 167): the Mediterranean and coastal towns (Tunis, Sale, Tangier, Algiers, Susa); the desert and oasis towns (Kairwan, Wargla, Guemar and Tamelhat) and the hinterland towns (Constantine, Fez and Meknes). But, when looked at from the point of view of the fundamental morphological property of integration, it is clear that Category Two with 5 towns out of 12 (Tunis, Susa, Sale, Wargla and Kairwan) include systems from different geographical locations (i.e., Sahara and Mediterranean coast) that are characterized by opposite climatic conditions. This is also the case for coastal towns where there is a great variation in the level of integration between for example, Sale (1.185) belonging to Category Two and Tangier (1.7726) belonging to Category Three. For the oasis towns, the variation in the level of integration is even more striking. For example, Tamelhat presents the strongest level of

integration of all systems (0.8475), while Wargla also located within the same general climatic conditions presents a much weaker integration (1.149) which belongs to Category Two. This by itself casts doubts upon the interpretations which hold climate as a chief responsible factor in the determination of the grid pattern, such that the winding street structure is as such as to act as a temperature regulator by providing shade and wind barriers (i.e., Fathy H., 1973, p. 320). Precisely the opposite prevails in some of the desert cities where the street structure is less broken up and presents an almost perfect orthogonal layout (i.e., Guemar or Tamelhat).

When the 12 towns are classified according to the topography of their site, they fall into three categories: towns built on flat terrain, towns built on gentle slopes, and towns built on very steep site. Among the towns built on flat site, are all of the oasis towns (Kairwan, Wargla, Guemar and Tamelhat), but also Sale. It is clear that these systems show again great variations both in their level of integration and other key spatial properties. Similarly, among the hill towns (Tangier, Algiers, Susa, Fez and Meknes) or towns built on a gentle slope (Tunis and Constantine) there are also marked differences in their level of integration, with Susa or Tunis forming part of Category Two, while the others of Category Three, including Constantine.

On the other hand, in Category One and Two of integration, there are towns known as holy places (Kairwan), others as important trading sea and desert ports (Tunis, Wargla) or as centres of religious sectarianism (Guemar, Tamelhat). This variation shows that there does not seem to be any strong relationship between the spatial

structuring of the towns and their prevalent function. Similarly, systems of Category Three, that is systems which are much more segregated (Constantine, Meknes, Fez, Tangier, Algiers) also display variations in terms of their prevalent function, showing once more no relation between the spatial structure of the towns and these criteria used in the classification of Arab towns. For instance, Meknes and Fez are known as princely towns; while Tangier and Algiers are known as sea ports and strongholds for piracy. This variation in the dominant function seems not to be expressed spatially, as towns with similar dominant character (i.e., trade centres: Tunis or Tangier; Fez or Wargla) present strong spatial differences, and towns with different dominant function present some spatial similarities.

Clearly, all these variations point to one general conclusion that is, there is little relation between the spatial structure of Arab towns and the three factors (climate, topography, function) most commonly used in their classification. Therefore, any attempt to explain the distinctive characteristics of the grid structure in these towns in these terms cannot be satisfactory. It cannot account for any of the observed variations.

So, where should one look for an explanation? what is the primary generator, if any, of the patterns of similarities and differences observed in the towns under study? The syntactic findings suggest that the relations between the visual shape of the grid, the degree of integration, the degree to which local and Radius-3 cores link up, the regionalization of the core and its close parallel to the

regionalization to the market streets, and the non-existent relation between syntactic intelligibility and theoretical "probabilistic" movement interface together with the strong relation between intelligibility and interface potential, are the fundamental morphological properties. All of these could be brought into a general theoretical scheme, if it were hypothesized that these towns are structured to first, regionalize the "inhabitants-strangers" interface; and second to globalize to a greater or a lesser degree the "inhabitants-inhabitants" interface or "quarter-quarter" interface.

In the first instance, all of the generic properties point to the fact that the overall structure of Arab towns might be held to be geared at a global level not towards generalizing and facilitating movements and exchange, but on the contrary, towards controlling and compartmentalizing movements. The relatively high level of route complexity expressed by a very low level of integration and which is likely to be encountered on long journeys inside the towns, might be held to work in discouraging outsiders from wandering around unnecessarily and perhaps even keep the rate of random trips to a minimum. The lack of spatial guidance, expressed by the low intelligibility measure and by the lack of correlation between intelligibility and movement interface (i.e., the theoretical probabilistic interface between inhabitants and strangers), represents a second level of complexity that might be experienced when moving in these towns. These built-in devices of control could be seen to be supported by the third dimension: the streets are on the whole constituted by windowless walls and are narrow, and when covered by houses bridging over appear like real tunnels. This quantified high level of route complexity has been experienced by

many visitors to these towns, who as seen in Chapter Two, reported to keep losing their way when moving inside these systems (i.e, Hammerton J., 1973, p. 246).

The built-in spatial devices of control in the grid structure of Arab towns is further demonstrated by the regionalized type of urban core the 12 towns present. The non-covering type of core of Arab towns in contrast to the "deformed-wheel" core type implies a different way of regulating the interface between the inhabitants and the strangers accessing to the system through the town gates. According to Hillier (Hillier B., 1986, pp.17-18), a "deformed-wheel" core type by its very nature, would make the accessing of strangers easy and would ensure that their movements cover the system in several directions, from the surroundings to the centre, and across the system. But, the "deformed-wheel" core would also ensure that the movements of the inhabitants inside the system and from the more segregated parts, continuously intersect the spaces where the strangers move. By doing this, this core type would create a strong "probabilistic" interface between the inhabitants and the strangers. Therefore, a system which presents a core approaching the "deformed-wheel" type may be held to be geared more towards facilitating the accessing of strangers and increasing their interface with the inhabitants.

By analogy, a system with a core confined to a smaller part may be held to be geared more towards controlling the movements of strangers and thereby, restricting their interface with the inhabitants to the area where the core is located. The cores of the towns under study which are in many respects non-covering and representing only one aspect of the "deformed-wheel core", might be

held on the basis of the spatial evidence alone, to be geared more towards controlling than facilitating the access of strangers.

Thus, although the towns under study have shown a tendency to "localize" or "regionalize" their cores to particular areas, the way in which this is realized in space seems to vary from one town to another. In general, it may be said that these towns may be seen as geared more towards the restriction of the movements of strangers to the area where the market and shopping streets are located, resulting therefore in the strong segregation of large parts of the systems. Against this general property to structure the inhabitants-strangers interface in a particular region, the degree to which the local parts combine to form an overall structure or a kind of a "semi-supergrid" might be held to be a function of the degree to which the grid produced an interface of the different groups of inhabitants with each other. By and large, this goes with the integration: the more integrated a system is, the stronger the inhabitants-inhabitants interface. In other words, what seems to be happening is that, variations in integration seem to imply variations in the inhabitants-inhabitants, or quarter-quarter interface.

Given these hypotheses, a more useful view of what "privacy" is and how it seems to be achieved in Arab towns may be therefore formulated. "Privacy" in these towns may be seen to be created more by the overall structure of the grid and its high level of deformation rather than by an "over-hierarchization" of groups of dwellings and an "over-separation" of the public buildings from the residential area; more by the spatial differentiation of the parts rather than their physical separation. As such, the grid structure itself may be held to

work as a system of regulating encounter patterns, that is as a system of control of unwanted "natural" interface, but not its suppression.

The implication of this may be better seen in the context of design, as it introduces a new dimension in the design of housing areas within the present cultural context and opens up design alternatives and choices of grid patterns. This particular point will make the main concern of the epilogue which looks at the extent to which the regulation of the overall grid deformation can be used as a main concept in design of housing layouts.

The main factors, therefore in explaining both the generic properties of Arab towns and their typological differences might be held to arise from a single dominant principle: the degree to which the structure of the town is globalized to produce, first a certain type and degree of interface between inhabitants and strangers, and second a certain type and degree of interface among the inhabitants of the different quarters of the towns. The first of these would seem to define the generic similarities of the towns: the regionalized cores, the weaker relation between connectivity and integration and the fairly stronger relation between integration and intelligibility, the absence of a relation between intelligibility and the inhabitants-strangers movement interface and the strong relation between intelligibility and inhabitants-inhabitants interface; the second, the generic differences: the degree to which the supergrid links the quarters, the differences in the overall integration, the degree to which integration of quarters is better than the integration of whole and the degree to

which the radius-3 integration core covers the system, rather than co-inciding with the global core.

What conclusions should therefore be drawn for the conventional stereotype of the "Arab town"? First, it is clear that the stereotype cannot be dismissed out of hand. There are generic features of Arab towns, which make them unlike other towns, and the morphological features the conventional view points to as characterizing this generic type overlap in many respects with the morphological features that emerge from this analysis.

On the other hand, it seems an unavoidable conclusion from the analysis that the generic properties found in Arab towns do not justify a single morphological stereotype, any more than they justify a simple functional stereotype as explanation. A more careful description is called for, as a result of which both concepts of what constitutes a generic morphological type and of what constitutes a typological property need to be revised.

Specifically, it might be said that the stereotype view of the Arab town is right in pointing to the existence of generic properties, wrong in turning them into simple universal principles of form with a universal explanation; right in pointing to the peculiar properties of the grid, wrong in the emphasis given to the cul-de-sacs; right in pointing to the distinctive way in which public facilities feature in the urban grid; wrong in assigning this primarily to the mosque as a generator; right in pointing to the importance of the local, or quarter structure of the towns, wrong in assigning this to a simplistic morphological description in terms of "hierarchy".

Does this lead to the conclusion that the stereotype needs to be revised more than abandoned? This would be to concede too much. The fact that the stereotype gives the analyst useful clues about where to look for the distinctive spatial properties of Arab towns does not condone the fact that its morphological characterization is over-generalized and rests at least in part, on that kind of thinking that often characterizes cultures in search of their own history. Arab towns are more complex and differentiated than the stereotype allows. It does no service to the Arab culture to limit the history of its urbanism within the nebulous confines of a myth.

But it is in the attempt to apply the stereotype and its explanations at the level of design that the myth ceases to be merely a cultural cul-de-sac and becomes actively pernicious. The lack of precision in morphological description of the Arab towns has given rise to a traditionalist design practice, in which the results of attempting to design within the stereotype have created built realities which seem to bear no practical imprint of the Arab urban past. The stereotype through its application in design has created a disjunction in the Arab culture, between a weak and over-generalized view of the past and an alien present in which all traces of the Arab culture seem lost.

In the Epilogue which follows, these issues will be taken up in two ways. First, the Epilogue will briefly look at a number of designs which allegedly attempt to re-interpret the stereotype, but which have the real effect of creating a totally new type of environment. Second, it will, with equal brevity, consider the possibility of using the results of morphological analysis in design, by adapting the outcomes of computer experiments by Salah-Salah in attempting to

generate the structure of Arab towns by a cell-growth process (Salah-Salah F., Ph.D thesis, 1987).

SUMMARY:

The present study has described the physical form of Arab towns as an entity in itself, that is in terms of its own intrinsic pattern prior to any reference to extraneous elements such as climate, function, economic or social factors. In this respect, the study has not deviated from its departing intention.

This chapter showed that grid structures of Arab towns presented generic properties, typological tendencies as well as morphological individualities, in contrast to the idea of a single city type. The chapter suggested then that the fundamental similarities and deep differences arise from the degree to which the structure of the towns is globalized to produce a certain type and degree of interface between inhabitants and strangers and also a certain type and degree of interface between the inhabitants of the different quarters.

EPILOGUE: A REFLECTION ON THE MODERN RE-INTERPRETATION OF ARAB TOWNS

The present section opens up a discussion on how the understanding of existing urban forms can be useful in the conception of new layouts. In other words, it questions the way in which urban design can benefit from morphological and analytical studies of actual forms. In this respect, an attempt is made to define, in the light of current design theories and practices, an alternative design approach whose prime concern is to explore possible design solutions on the basis of information derived "objectively" from the study of the spatial configuration of existing Arab towns. For this purpose, the present epilogue will first briefly discuss current issues in the theories of urban design in general, to focus then more closely on the "neo-vernacularist" design approach and spatial concepts adopted in the context of newly developed housing schemes. The epilogue ends up by presenting examples of housing schemes that have been worked out using partly randomised generative syntax as initiated by Hillier (i.e. Hillier B; Hanson J.; 1984) and later developed and adapted to specific questions by Coates (Coates P., 1982, PhD thesis) and Salah Salah (Salah Salah F., 1987, PhD thesis) on the one hand and on the other, using some general organising principles of spatial articulation derived from the study of the 12 town grids without however, losing sight with some aspects of modern planning requirements.

In the recent past, a strong tendency has been developing among architects practicing in Arab countries to re-orientate the design of

housing layouts along spatial concepts on which traditional housing forms are believed to be based. Since, the main theme in urban design is one essentially centred around a search for a spatial model where social requirements, such as family privacy which is regarded as a deeply rooted behavioural norm in Islamic societies, can be fulfilled. In other words, the main preoccupation of an urban design project is above all with finding an appropriate physical form for the social needs of Muslim societies.

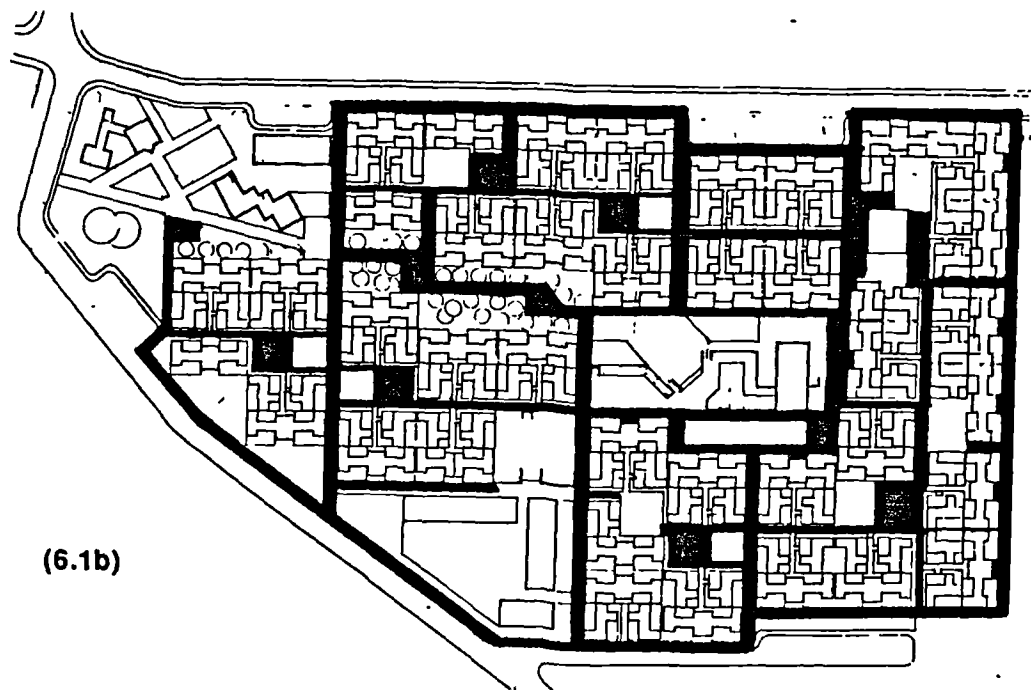
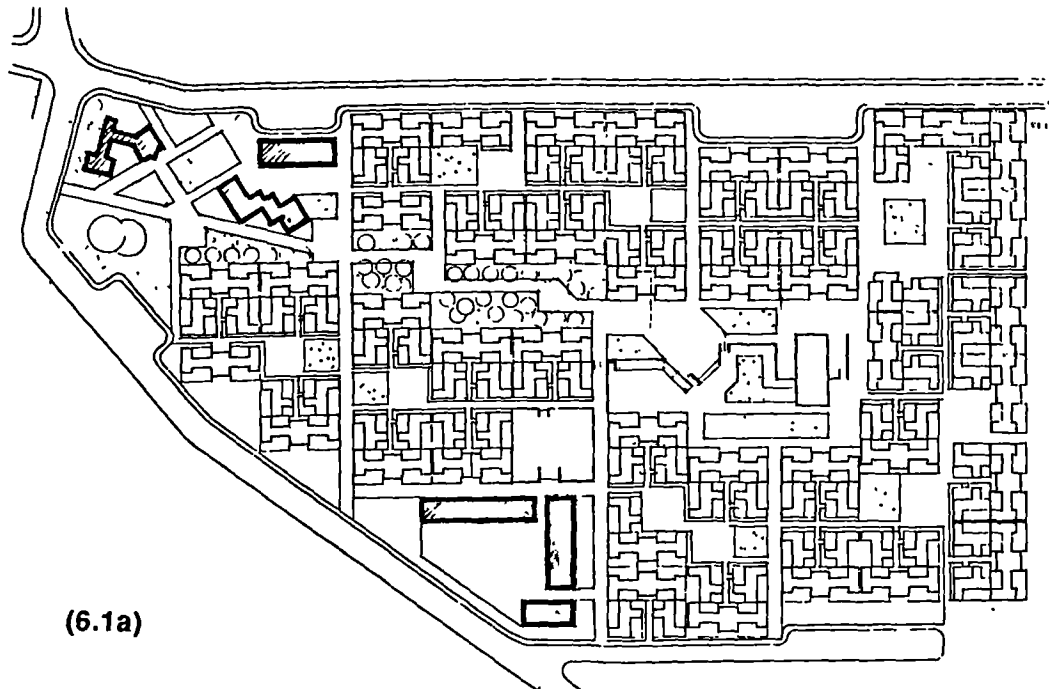
In this context, the current architectural discourse and design approach emerges as one which is geared towards the use of design concepts strongly associated with spatial demarcations and distancing devices. In other words, the notion of privacy was strongly associated with the introduction of enclosures. As a result, the "cul-de-sac" passage and the "communal courtyard" concepts became dominant as a means of ordering urban space.

The design approach which has gained most favour in dealing with the privacy requirement has used then a conceptual model based on hierarchised spatial sequences (private, semi-private, public spaces) with a certain spatial investment in their demarcation. The current design trend of housing layouts in Arab countries, uses the "enclave principle" initiated by H. Fathy in the 1940s' in the well known Gourni scheme in Egypt (i.e., Fathy H., 1973). That is to say, the innovation in the design trend of housing layouts consists of the introduction of a new element (the cul-de-sac passage, or the communal courtyard onto which give the front doors of the houses) in the design of layouts in order to distance the private space from the public, and therefore increase the privacy of the houses.

In line with this, the following section focuses on 7 modern housing layouts in Algeria, conceived on the basis of the "enclave principle" and characterized by a clear separation of the public facilities from the residential areas; a division of these latter into distinct units, and a three-fold hierarchised sequences of open space. The main argument is that if the adoption of such concepts in the design of housing layouts is capable of recapturing properties of the urban structure of Arab towns, then it ought to be possible to find some evidence of these properties in the new layouts themselves. A general presentation of these latter will be briefly outlined on the basis of a visual inspection of the plans followed by a cross-examination of the main properties of the sample of the 7 housing layouts against those of the 12 Arab towns, in order to establish the morphological differences (if any) they present.

DESCRIPTION AND ANALYSIS OF THE MODERN SCHEMES:

The ground plan of Souahia is shown in Figure 6.1a. This layout which is surrounded on three sides by a peripheral road with car parking areas, is made up of courtyard houses grouped into units of four, opening onto cul-de-sac alleys. These units are differently assembled to form blocks of various size and shape, which are in turn organized around a large central open space directly connecting to the peripheral road on several points. All the houses turn their back to the central public square and the roads connecting to it. The site accommodating the public facilities is pushed away into a remote corner of the settlement. The map in Figure 6.1b shows in black the amount of open space which entirely develops along blank walls



SOUAHIA

FIG. 6.1: GROUND PLAN



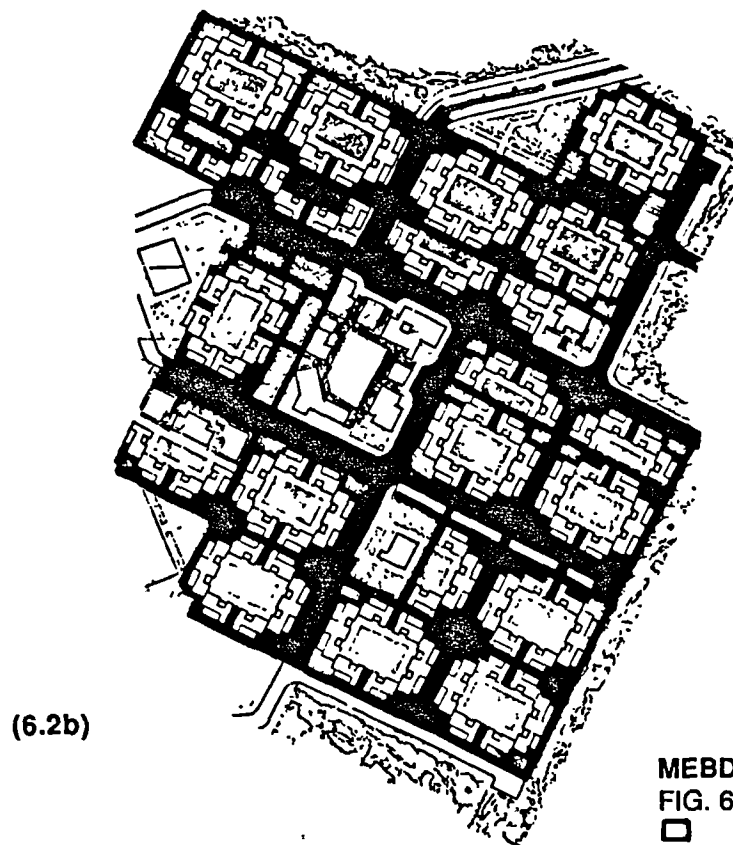
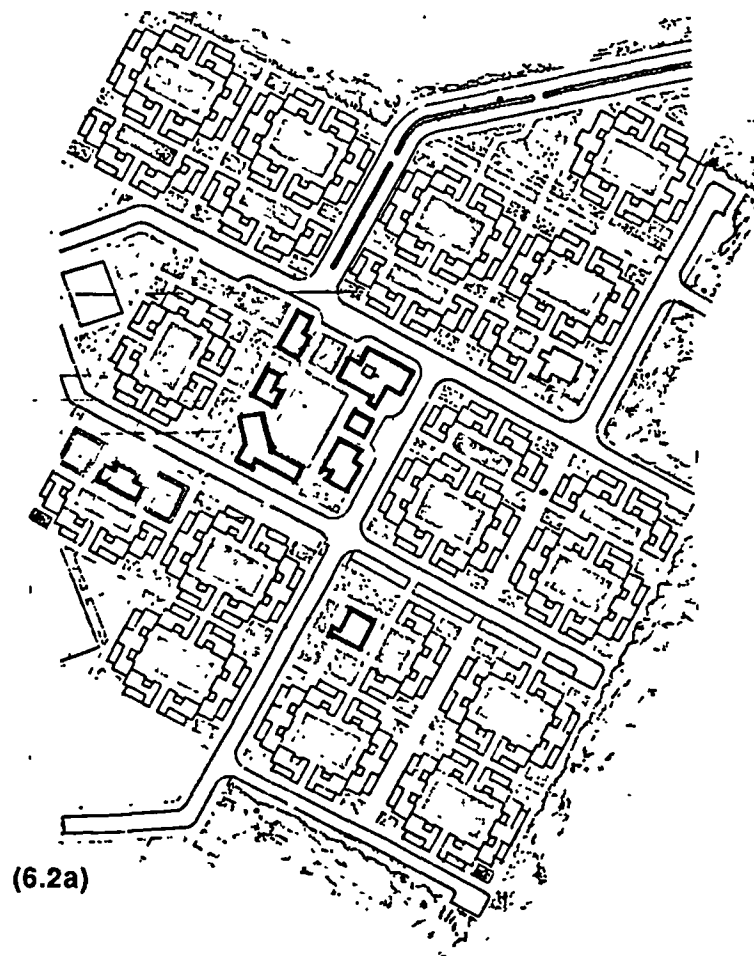
Public buildings
Unconstituted Streets
(with no building entrances)

(i.e., with no building entrance giving onto them) and forms a continuous structure.

Mebdaoua's layout shown in Figure 6.2a is chiefly composed by 6 residential compounds, each divided up into a group of sub-units of 8 and 4 houses, opening onto communal courtyards inter-linked by a system of pedestrian alleys. Similarly to Souahia, the 6 residential compounds defined by a regular street pattern, are organised around a central public square accommodating the main public facilities and directly linking to the outside. In this case also, the houses turn their back to the main square and the roads, resulting then in a continuous structure of open space with no building accesses giving onto them (see fig. 6.2b).

Figure 6.3a shows the site plan of Anouna. This settlement is made up of five large units of 42 courtyard houses each (1500 inhabitants) opening onto communal courtyards and cul-de-sac alleys. These units are arranged on both sides of the central road which links to the access gate building of the site which encloses several public facilities. The streets which form a regular pattern, develop almost entirely along blank walls as a result of the adopted enclosure principle as shown by the map (see fig. 6.3b).

The houses in Ain Amrane (see fig. 6.4a) are organised on both sides of the staggered main road to which connect loop roads leading to communal courtyards. The cul-de-sacs which give access to the houses connect to either the communal courtyard or to these loop roads, which in turn connect to a large square. The public facilities are also grouped in a remote corner of the settlement, as in Anouna or



MEBDAOUA

FIG. 6.2:

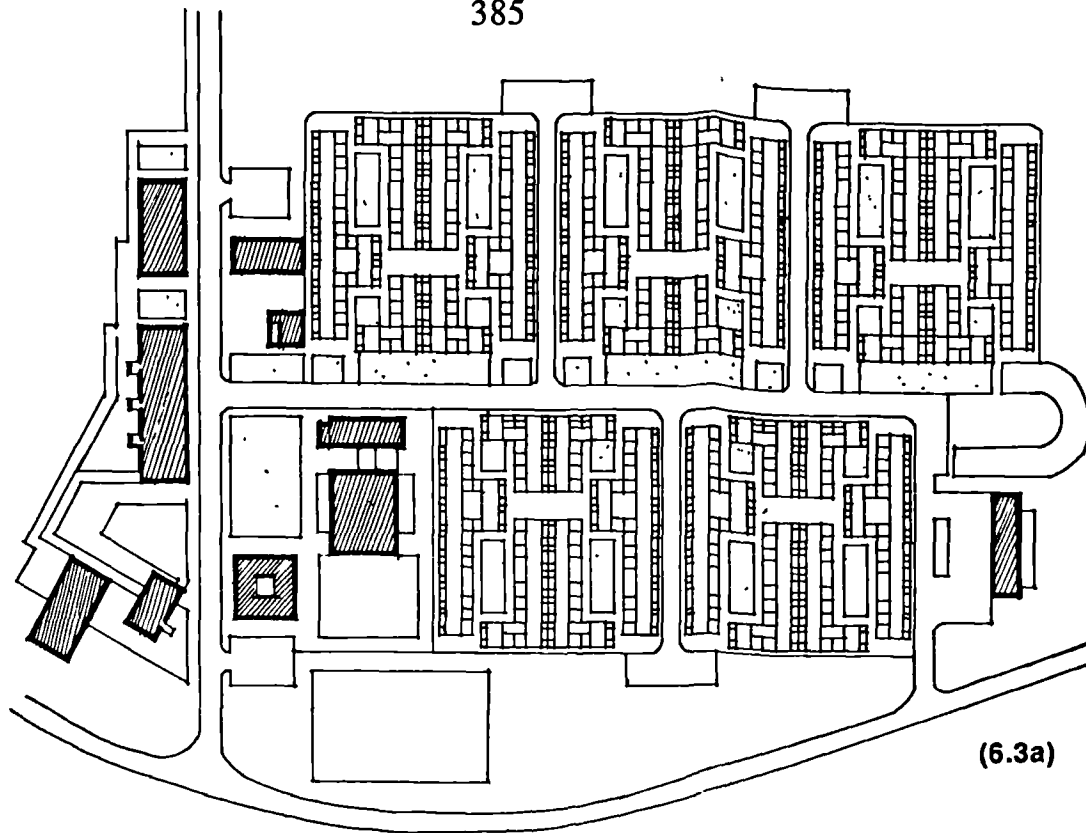
GROUND PLAN



Public buildings



Unconstituted Streets
(with no building entrances)



ANOUNA

FIG. 6.3:

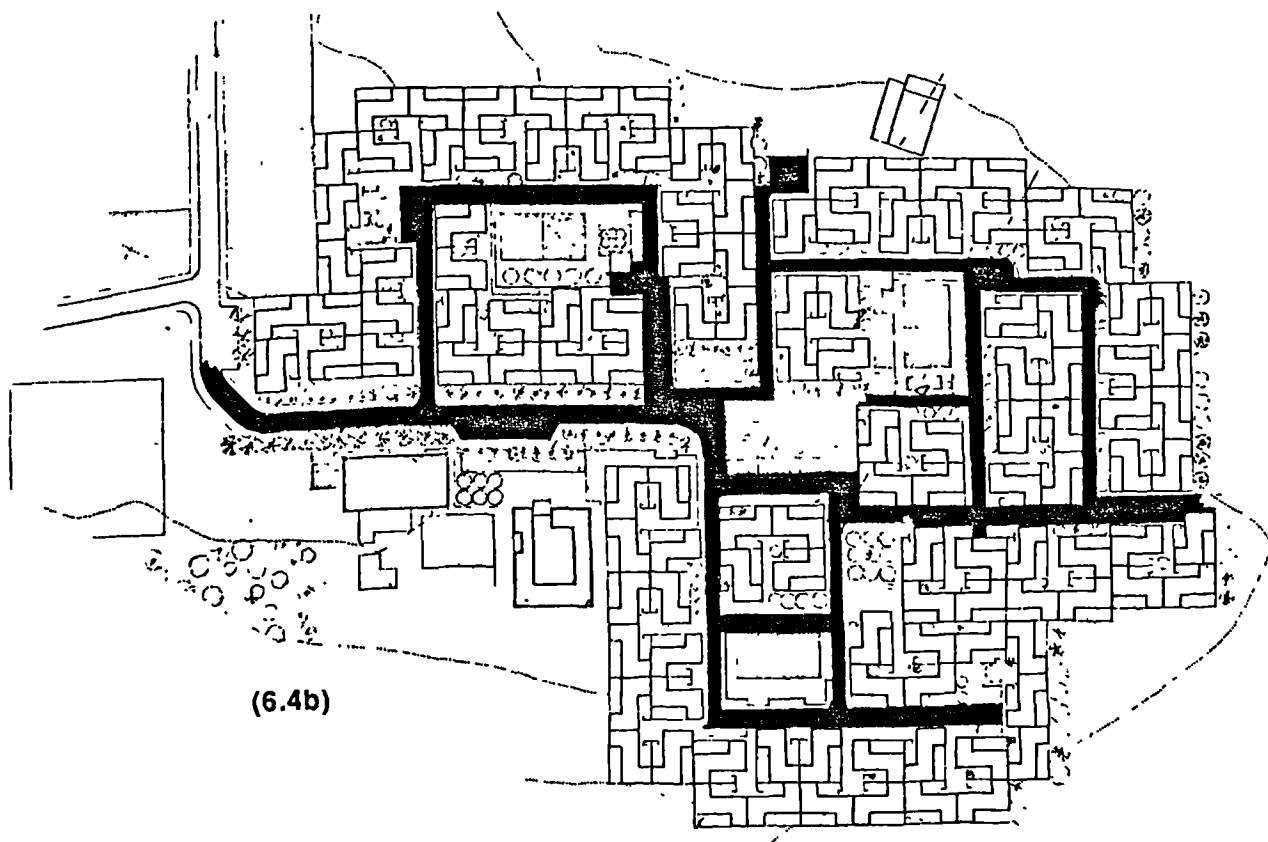
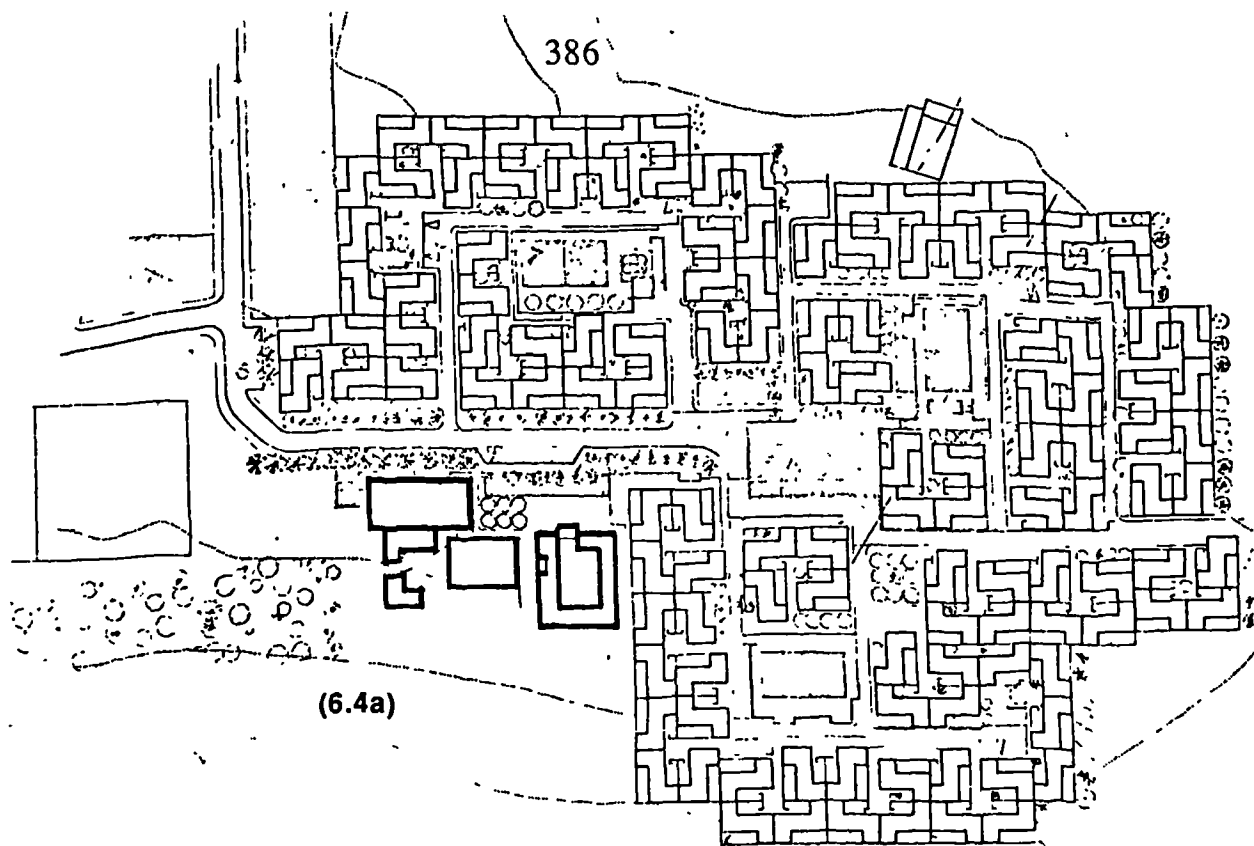


GROUND PLAN

Public buildings



Unconstituted Streets

(with no building entrances)



AMRANE

FIG. 6.4: GROUND PLAN

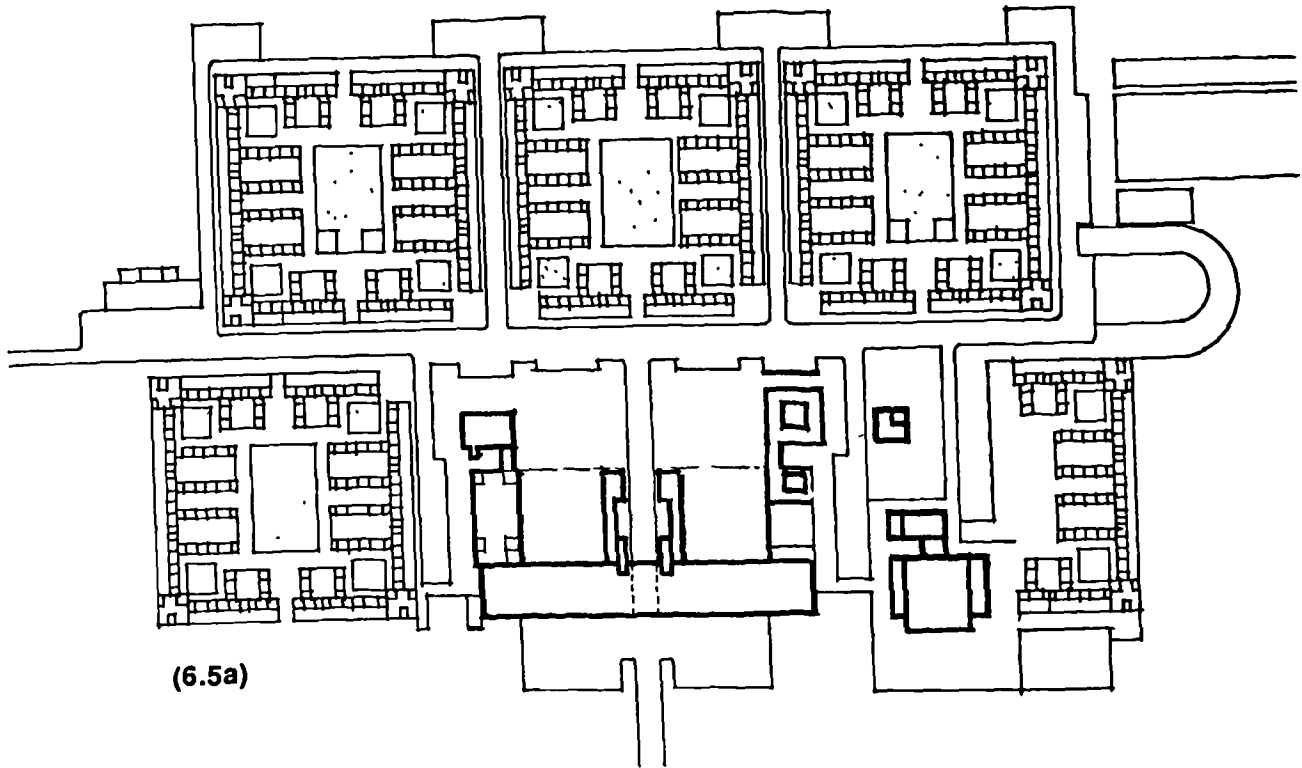
-  Public buildings
-  Unconstituted Streets (with no building entrances)

Souahia. The map in 6.4b shows that a large part of the street system is left without building entrances opening onto them.

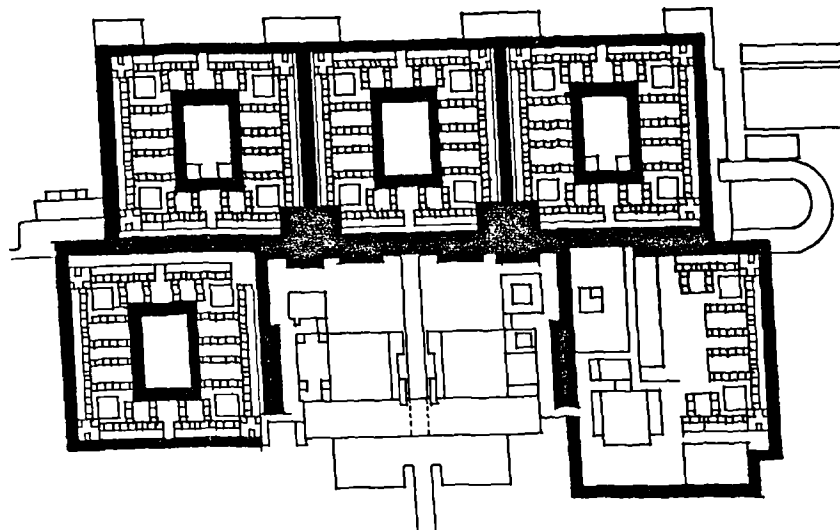
The ground plan of Damous is shown in Figure 6.5a. This scheme is made up of five residential units which contain approximately 50 dwellings (about 1000 inhabitants), each arranged around a common central space. The public and commercial centre forms an access gate building to the village and encloses several facilities grouped around two adjacent squares surrounded by porticos. Similarly to the other cases, the inward looking character of the residential blocks clearly leaves most of the street system continuously constituted by blank walls (see fig. 6.5b).

Abadla's scheme by contrast to the others, is enclosed within walls with 8 access gates. It is made up of 8 residential units of approximately 40 dwellings each, organised around a central public square directly linked to the outside and where the public facilities are located (see fig. 6.6a). The plan shows that the residential units are divided up into sub-units of 4 dwellings opening onto a small communal courtyard; and a group of 4 of these units are then arranged around a larger square to which they turn their back. The plan exhibits a rigid geometrical order with the four main streets intersecting at right angles and linking directly to the ring road. The map in Figure 6.6b shows the system of open space that is constituted by blank walls of buildings.

The ground plan of Saada is shown in Figure 6.7a. This scheme is made up of four units of about 28 courtyard houses each, arranged around a common central space containing the key public facilities



(6.5a)



(6.5b)

DAMOUS

FIG. 6.5:

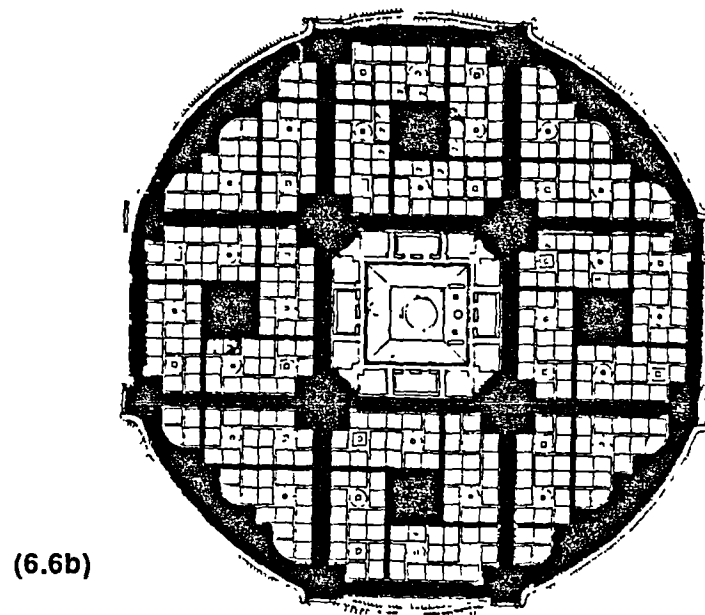
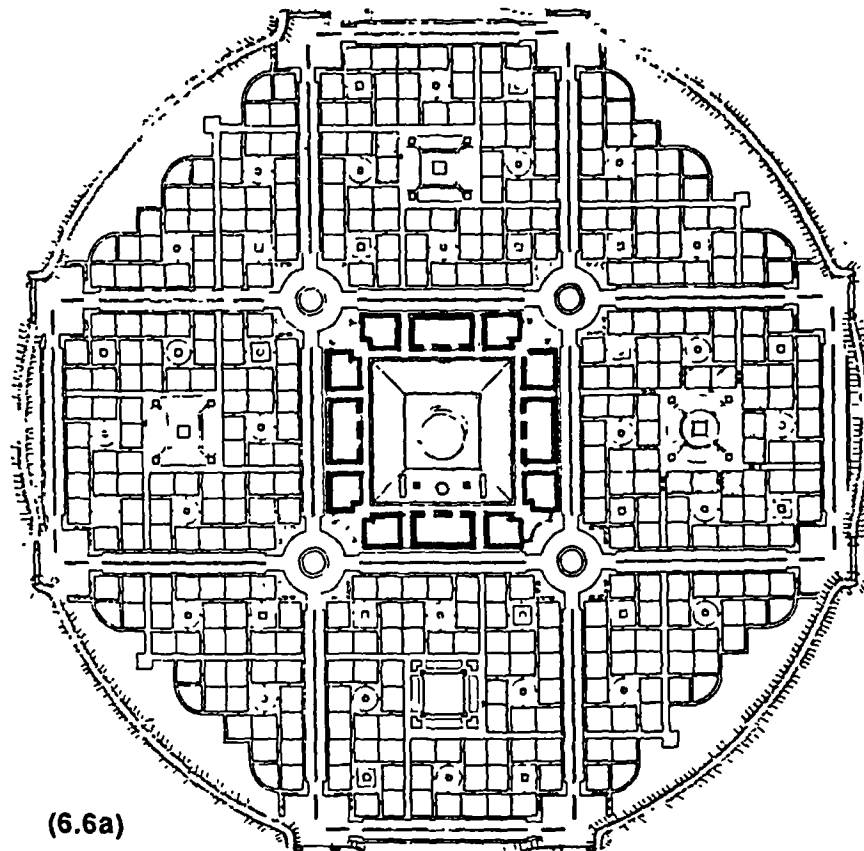


GROUND PLAN

Public buildings

Unconstituted Streets

(with no building entrances)



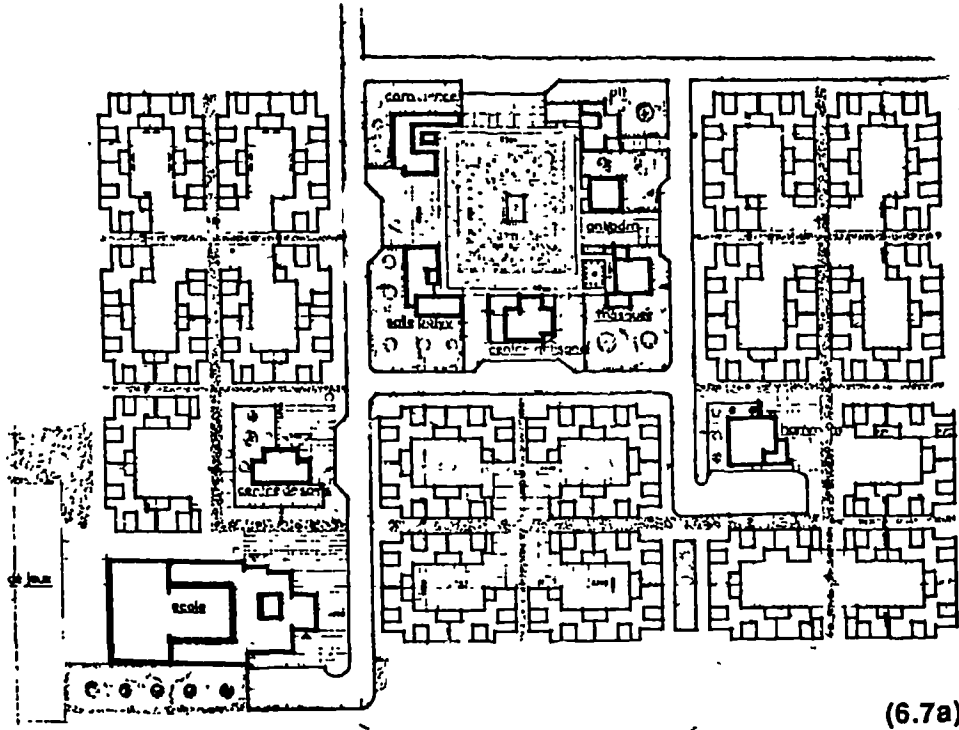
ABADLA

FIG. 6.6:

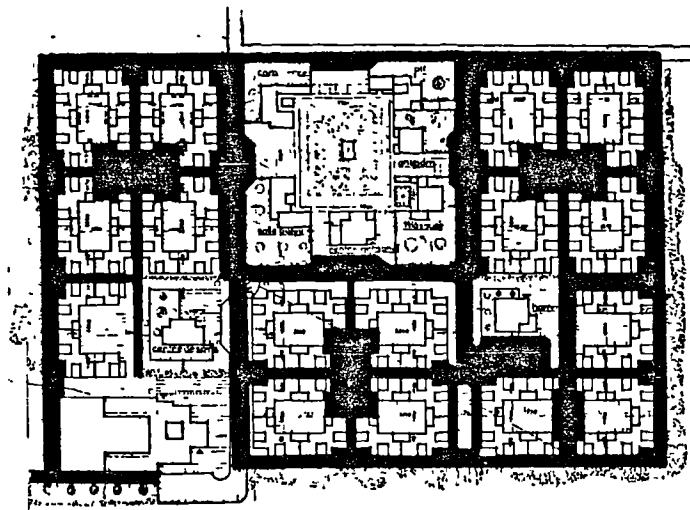
GROUND PLAN



Public buildings
Unconstituted Streets
(with no building entrances)



(6.7a)



(6.7b)

SAADA
FIG. 6.7:



GROUND PLAN
Public buildings
Unconstituted Streets
(with no building entrances)

and directly connected to the outside. Each residential unit of 7 dwellings is organised around a internal courtyard, and this spatial arrangement has the effect of leaving most of the streets totally "unconstituted" and bounded by blank walls (see fig. 6.7b).

One of the striking characteristic common to the seven modern layouts is the unconstituted grid. This seems to be a totally new phenomenon resulting from the inward-looking clusters, the over-hierarchisation of the dwelling groups and over-separation of public and residential areas. The black-on-white maps clearly showed that every modern scheme is based on a regular grid devoid of building entrances, fundamentally differing from those observed in the 12 Arab towns (see fig. 1.2, p. 37).

The following section aims to examine the spatial properties of 7 modern layouts against the background of the studies of the 12 traditional urban systems, in order to establish what is distinctive about these newly built settlements taken as a group and how far their general spatial properties differ from each other and from those of the traditional spatial layouts. The syntactical measures of the 7 modern layouts taken as a group are set up in Tables 6.1 and 6.2 and the detailed measures for each of the 7 layouts are set up in Table 6.3.

	CN	RRA	CV	CH
MEAN (r:logK)	3.9490 (-.0075)	0.6860 (.3128)	- -	0.0450 (-.8374)
MAX. (r:logK)	14.714 (.7982)	1.0090 (.2049)	4.5370 (.5081)	0.3890 (-.0447)
MIN. (r:logK)	2.286 (-.2026)	0.3420 (.4751)	0.2890 (-.4734)	0.002 (-.821)
ST DEV. (r:logK)	2.262 (.8622)	0.164 (-.0414)	0.716 (.2762)	0.068 (-.335)

TABLE 6.1: MEANS OF FIRST ORDER MEASURES FOR THE 7 MODERN LAYOUTS

	1:RA/CN	1:RA/RCH	CN/CH	CV/CH
MAX.	0.903	0.926	0.948	0.956
MEAN	0.770	0.827	0.920	0.852
MIN.	0.596	0.648	0.873	0.736
ST. DEV.	0.166	0.163	0.047	0.110
r:K	-.338	-.200	-.356	-.639
r:log K	-.556	-.422	-.473	-.766
r:log K controlling mean RRA	-.484	-.304	-.470	-.799
MEAN RRA	-.597	-.633	-.089	-.688
MEAN RRA controlling for log K	-.536	-.582	-.070	-.734
(1:RA/CN)		0.961		
(1:RA/CN) controlling for log K		0.964		
(1:RA/CN) controlling mean RRA		0.938		

TABLE 6.2: MEANS OF SECOND ORDER MEASURES FOR THE 7 MODERN LAYOUTS

From the above tables, it appears that from the point of view of first order measures, the sample of the 7 modern layouts present marked differences in their grid structure, when compared to the 12 Arab towns. These are highly connected (mean CN=3.949, compared to 3.076 for the 12 towns) and highly integrated (mean RRA=0.686, compared to 1.421 for the 12 towns). The maximum connectivity which is much higher than the one given by the 12 towns (max. CN=9.333 for the 12 towns), correlates strongly with size, which is not the case of the 12 towns (0.1954). Similarly, by contrast to the 12 towns, the mean integration does not correlate with size. Table 6.2 which sets up the second order measures for the 7 modern layouts, shows further differences which are summarized in the following.

The 7 the modern layouts are clearly more intelligible (mean $1:RA/CN = 0.770$, compared to 0.536 for the 12 Arab towns) and present a stronger movement interface ($1:RA/RCH$) than their counterpart traditional systems (0.621). These modern layouts showed also marked differences in the way in which the first and second order measures related to each other and to size. Table 6.2 shows also that the level of movement interface of the modern layouts is clearly governed by the intelligibility of these systems, regardless of size and integration. The correlation between the two second order measures (Intelligibility and movement interface) is very high (0.9608) and remains so when size or mean integration are controlled for, by contrast to the 12 towns where there is no correlation.

Table 6.3 sets up the detailed numerical properties of each of 7 the modern layouts according to the three versions of the plans as in the analysis of the 12 towns, that is the distributed system, the system with the dead-end spaces and the system without the peripheral spaces.

	SOUAHIA	MEBDAQUA	ANOUNA	AMRANE	DAMOUS	ABADLA	SAADA	MEAN
SIZE	48 97 43	121 - 117	86 - 80	28 49 20	58 108 51	140 - 132	13 22 9	70.57 69 64.57
MEAN CN	3.5417 2.7835 3.0233	3.2562 - 2.8889	3.1628 - 2.5750	2.9286 2.5306 2.8000	3.4483 2.7778 3.1373	6.0714 - 5.1667	5.2308 3.9091 3.5556	3.9490 3.0002 3.3066
MAX. CN	10 12 8	16 - 14	20 - 17	10 11 8	20 20 16	19 - 17	8 11 6	14.714 13.500 12.285
MEAN RRA	0.7272 0.8707 0.9388	0.7941 - 1.0060	0.7907 - 1.1242	0.8288 0.8579 0.8522	0.7316 0.9791 0.9475	0.5099 - 0.5972	0.4230 0.6364 0.5512	0.6860 0.8360 0.8595
MAX. RRA	1.1365 1.1874 1.3175	1.1074 - 1.7575	1.1999 - 1.6182	1.2573 1.1754 1.2731	1.0688 1.4729 1.7298	0.6890 - 0.8506	0.6049 1.0889 0.7892	1.0090 1.2311 1.3337
MIN RRA	0.4262 0.5060 0.6349	0.3824 - 0.4988	0.4039 - 0.5020	0.3484 0.3940 0.3378	0.3253 0.5042 0.4216	0.2906 - 0.3359	0.2200 0.3333 0.2255	0.3420 0.4340 0.4223
1.RA/CN REL.	+0.581 +1.087 -1.610	+0.789 - +0.0058	-1.020 - -2.784	+0.319 +0.398 -0.212	-1.061 -0.816 -1.469	+1.1625 - +1.1270	+0.468 +1.1261 -0.196	+0.243 +0.482 -0.0070
1.RA/RCH	+0.346 +0.023 +0.556	-0.047 - -0.0978	-1.055 - +0.082	+0.412 +0.664 +0.552	-0.495 -3151 -2003	+2.288 - +1.933	+0.230 -2075 -0.337	+0.239 -1.134 -0.027
CN/CH	0.87 0.88 0.82	0.93 - 0.88	0.92 - 0.86	0.94 0.91 0.94	0.93 0.90 0.90	0.90 - 0.85	0.95 0.83 0.96	0.8470 0.8800 0.8870
CV/CH	0.83 0.66 0.76	0.74 - 0.64	0.84 - 0.82	0.87 0.64 0.91	0.86 0.78 0.78	0.86 - 0.79	0.96 0.98 0.97	0.7260 0.7650 0.8100

TABLE 6.3 GENERAL DATA TABLE FOR THE 7 MODERN LAYOUTS

The mean connectivity fluctuates around 3, but in two cases it is extremely high (6.0714 in Abadla and 5.2308 in Saada). These systems show strong variation with respect to the maximum connectivity, which reaches 20 in three cases (Damous, Anouna and Abadla); but in three other cases, it does not go beyond 10. The mean integration on the other hand, varies between 0.70 and 0.80, but in two cases it reaches a very high level (0.5099 for Abadla and 0.413 for Saada). When the dead-ends are taken into consideration, there is a clear fall in the level of integration which still remains relatively

high. This is also the case for the systems taken without the peripheral streets.

The relative intelligibility ($1:RA/CN$) of the systems is above average, except for Damous and Amrane. There is an improvement in the intelligibility of the systems when considered with the dead-ends, but a marked fall when the peripheral streets are omitted. The movement interface ($1:RA/RCH$) varies strongly in the modern schemes. It is average in Souahia, Mebdaoua, Amrane and Saada; very low in Anouna and well above average in Abadla. The movement interface decays strongly in the systems with the dead-ends of Damous and Saada. The results indicate also no consistent pattern of the movement interface of the modern systems considered without the peripheral streets: it remains constant in Souahia, Amrane and Abadla; but in Damous it sharply falls.

From this, it is clear that the 7 modern housing layouts, despite their common properties as outlined above, have also presented significant differences such that some systems are much more integrated than others (i.e., Abadla and Saada); while some present a much lower level of intelligibility than others (i.e., Damous and Amrane). But, the results consistently point to the marked effect the dead-end structure has on the integration of the modern layout, by contrast to the traditional forms.

The following section will examine the structure of the integration cores of the 7 housing layout. The integration core of Souahia (see fig. 6.8) develops along the peripheral streets connected to some

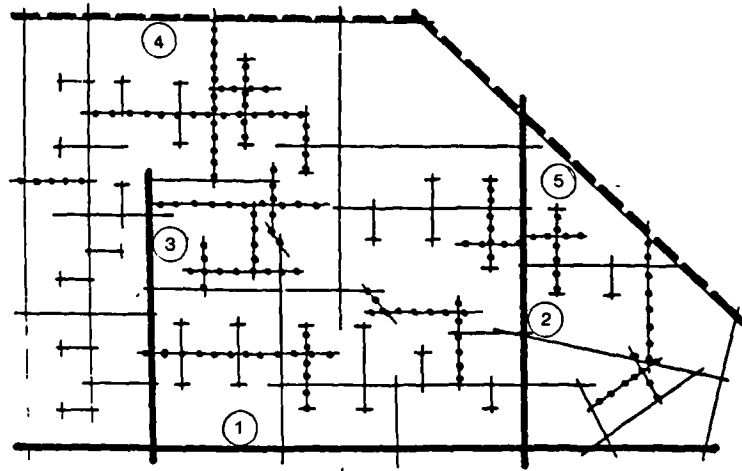


FIG. 6.8

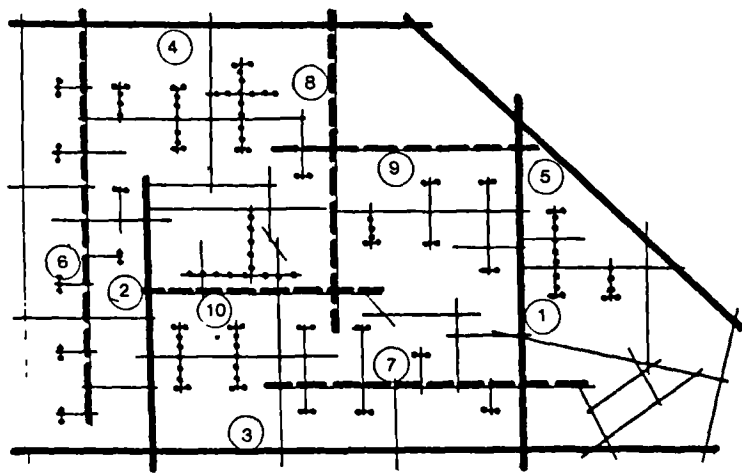


FIG. 6.9a

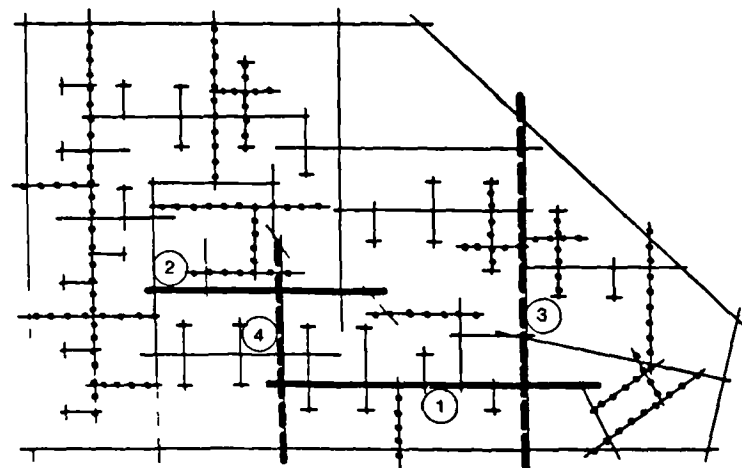


FIG. 6.9b

SOUAHIA

INTEGRATION CORES
 — 10% of most integrated lines
 50% of most segregated lines

internal lines. The integrated spaces run along the back walls of the houses. The first integrator corresponds to a peripheral street and meets the second best integrator at one corner of the settlement where some public facilities are located. The most segregated spaces are scattered all over the surface of the settlement. When the dead-ends are taken into consideration, the core expands more inside the system but still includes several peripheral lines (see fig. 6.9a); while the most segregated spaces correspond to all the dead-ends. When the peripheral streets are omitted, the core becomes more condensed and confined to one part of the system (see fig. 6.9b).

- **MEBDAOUA:** The integration core of Mebdoua forms an orthogonal grid structure which covers the whole system and surrounds the residential clusters (see fig. 6.10). These integrated spaces develop also along blank back walls of the houses. The first integrator runs adjacent to the town centre and crosses the entire settlement. The segregated spaces compound into separate clusters which correspond to the internal courts onto which the houses open. When the peripheral streets are omitted, the overall shape of the core in Figure 6.11 resembles strongly the core described above. This is also the case concerning the distribution of the most segregated spaces.

- **ANOUNA:** The integration core of Anouna is constituted by a central long axis and peripheral streets linked by several lines corresponding to streets which run on the edges of the residential clusters (see fig. 6.12). The most integrated spaces in this case also develop mainly along streets constituted by blank walls. The first, second and third best lines in terms of integration intersect at the edge of the system where the public facilities are located. The most segregated spaces

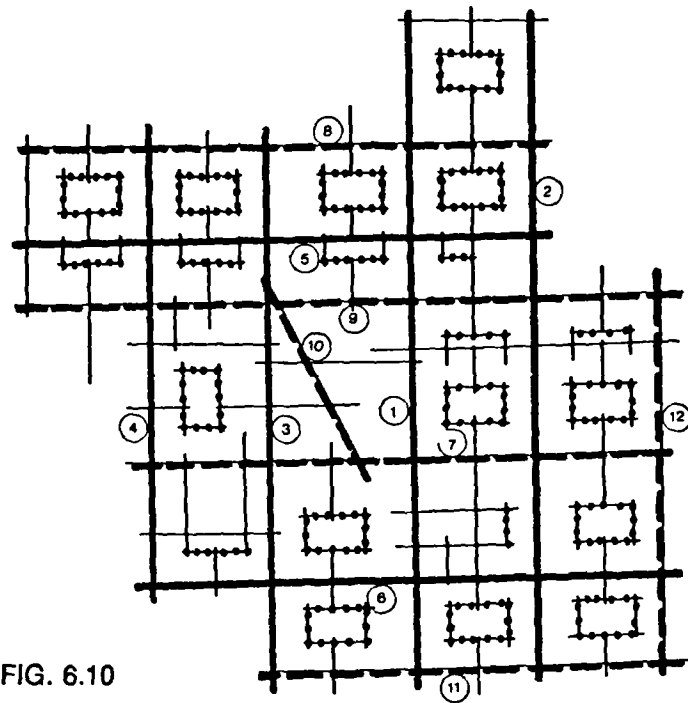


FIG. 6.10

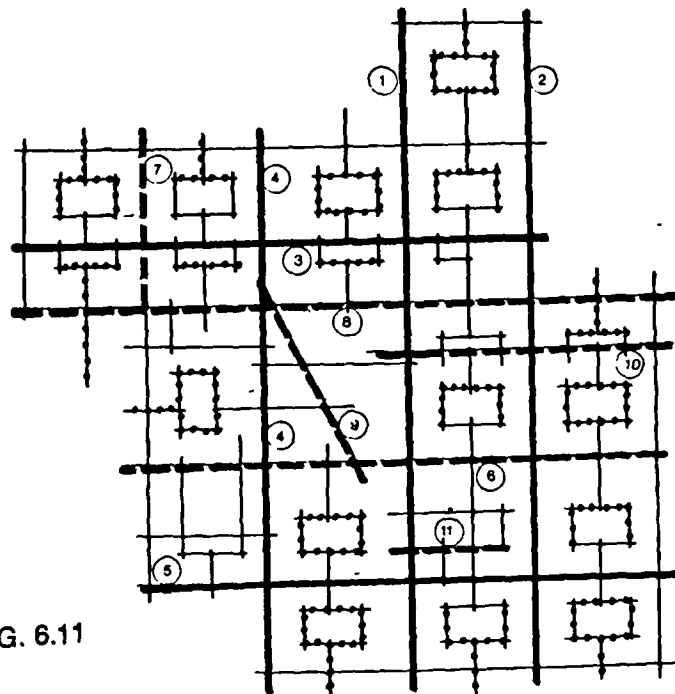


FIG. 6.11

MEBDAOUA

INTEGRATION CORES

- 10% of most integrated lines
- 50% of most segregated lines

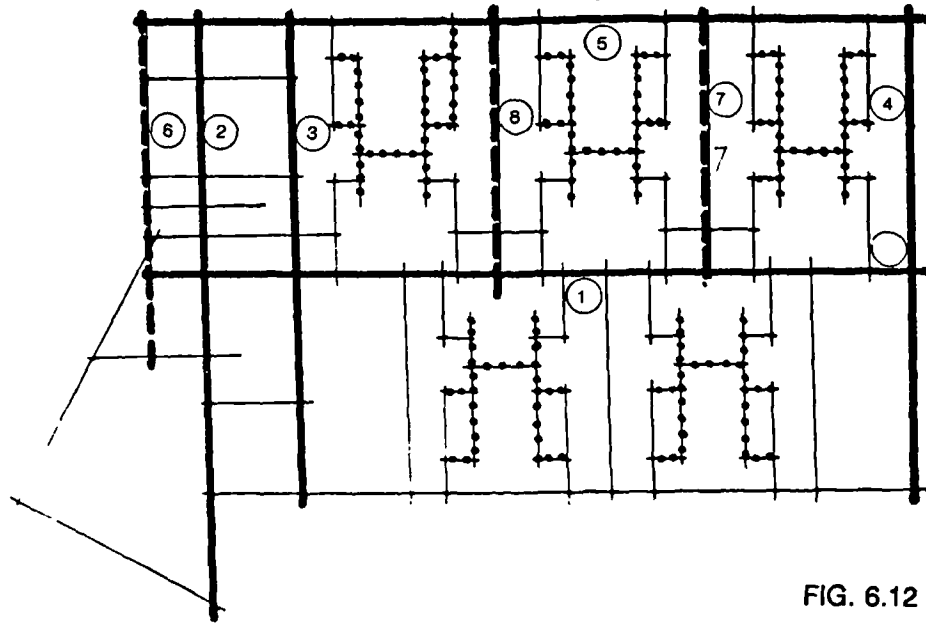


FIG. 6.12

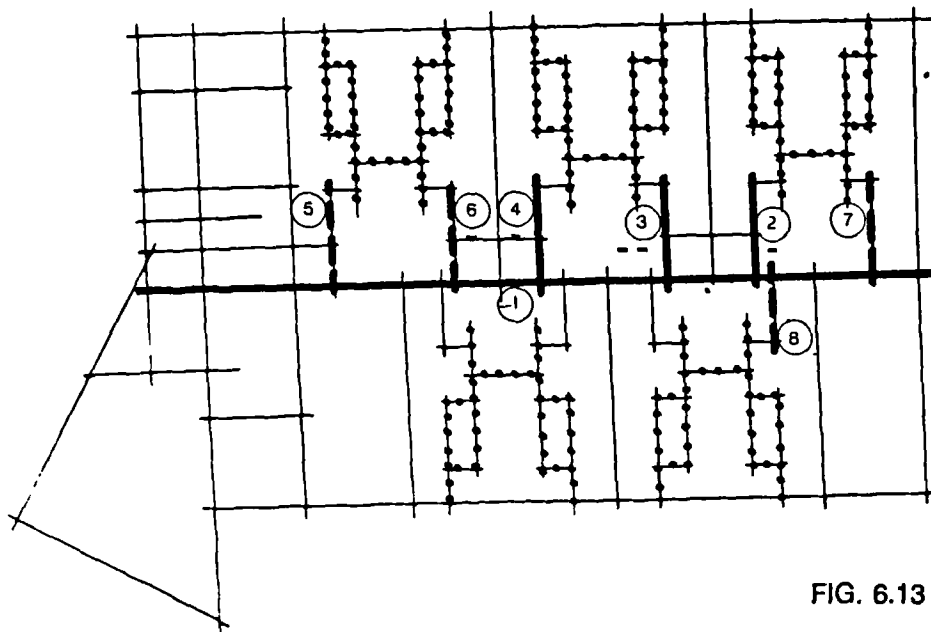


FIG. 6.13

ANOUNA



INTEGRATION CORES

10% of most integrated lines

50% of most segregated lines

form five distinct clusters inside the residential compounds. These segregated spaces correspond to the alleyways which develop inside the residential compounds which provide accesses to the houses. When the peripheral streets are omitted, the core becomes confined to the central axis with short lines running along the access spaces (see fig. 6.13). The segregated spaces include almost all the internal alleys.

- AMRANE: The integration core of Amrane shown in Figure 6.14 develops in the central part of the site. The integrated spaces intersect at the town square linking this latter to the outside, and run mainly along streets constituted by back walls of the houses. The most segregated spaces develop along the alleys from which branch off cul-de-sac passages that provide access to houses. When the system is considered with the dead-ends, the core does not differ strongly from the previous case (see fig. 6.15a). The most segregated spaces include almost all the dead-ends as well as some peripheral lines. When the peripheral streets are discounted, the most integrated and segregated spaces do not present important differences when compared to the system with the peripheral streets (see fig. 6.15b).

- DAMOUS: The integration core is constituted by a main central axis which traverses the system in one single step and from which branch off several lines linking to the outside (see fig. 6.16). The integrated spaces tends to run in the edges of the residential units without however penetrating into any of these units, and as a result the core runs entirely along streets demarcated by blank walls. The first integrator runs adjacent to the main public square accommodating the

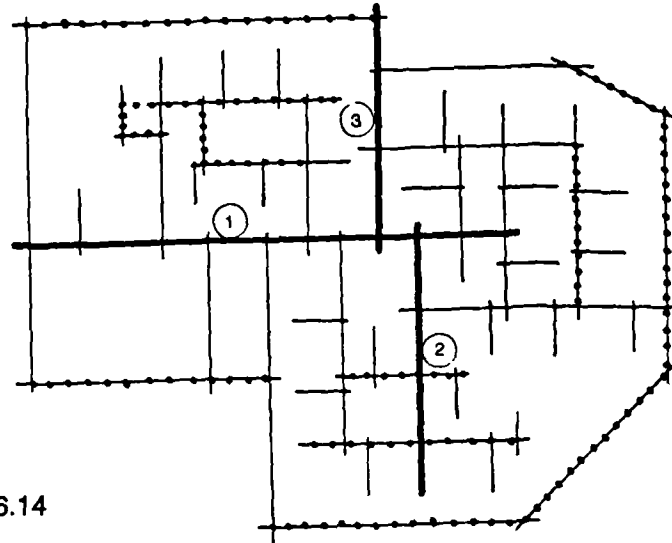


FIG. 6.14

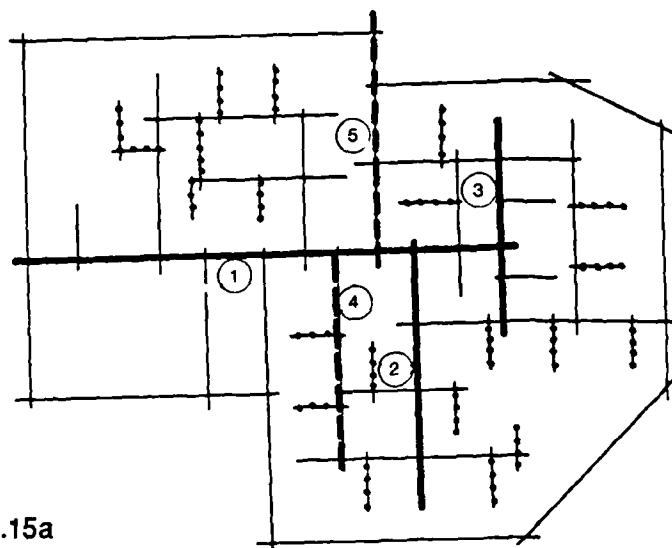


FIG. 6.15a

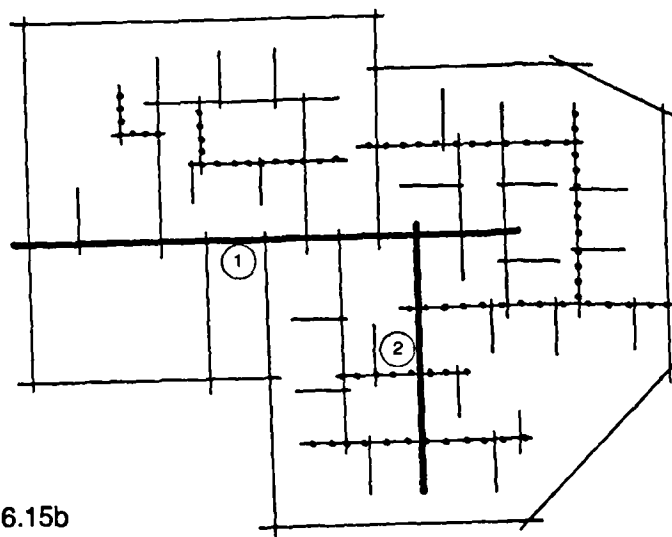


FIG. 6.15b

AMRANE

—
....

INTEGRATION CORES

10% of most integrated lines

50% of most segregated lines

FIG. 6.16

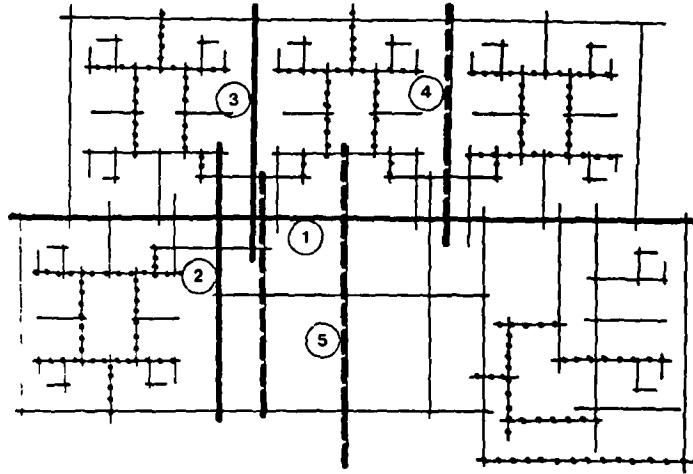


FIG. 6.17a

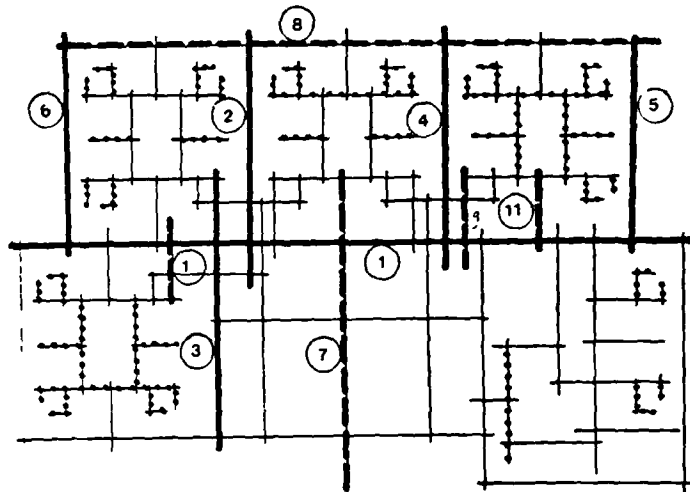
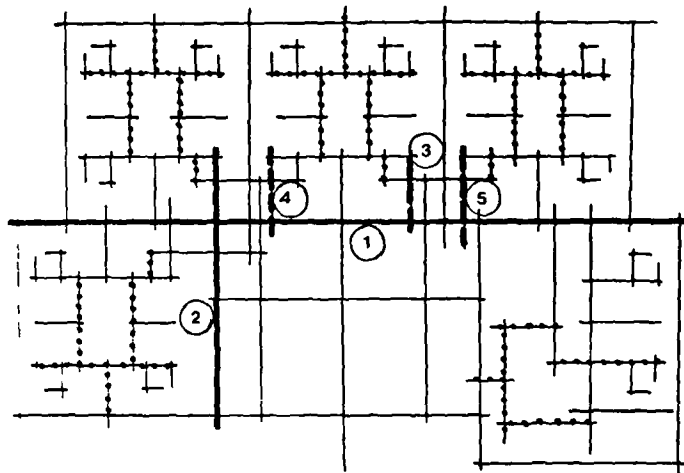


FIG. 6.17b



DAMOUS



INTEGRATION CORES
 10% of most integrated lines
 50% of most segregated lines

main public facilities. The most segregated spaces include the internal alleys of the four residential compounds. When the dead-ends are considered, the core remains unchanged except that it includes in this case peripheral roads; while the most segregated spaces consist of all the dead-ends onto which open the houses and some of the internal alleys (see fig. 6.17a). When the peripheral streets are omitted, the core in Figure 6.17b is still constituted by the long central axis, but includes also few lines which connect to some internal alleys of the residential units. Similarly to the previous case, the segregated spaces form clusters inside the residential units.

- ABADLA: The perfect geometrical form of the layout is strongly reflected in the structure of the integration core, which develops along the four main roads that directly link to the gates and around the peripheral ring road (see fig. 6.18). All these spaces do not have building entrances giving onto them. The most segregated spaces form eight distinct clusters at the interstices of the integration core. These segregated spaces correspond to the courts and alleys onto which open the houses. When the peripheral streets are discounted, the integration core remains on the four main roads but also includes lines penetrating inside the residential units, and linking the internal central courts of the units to the periphery and to the main roads (see fig. 6.19). The segregated spaces still develop inside the eight residential units.

- SAADA: The integration core of Saada in Figure 6.20 corresponds to the main axis which runs adjacent to the town centre and traverses the entire settlement; while the most segregated spaces include

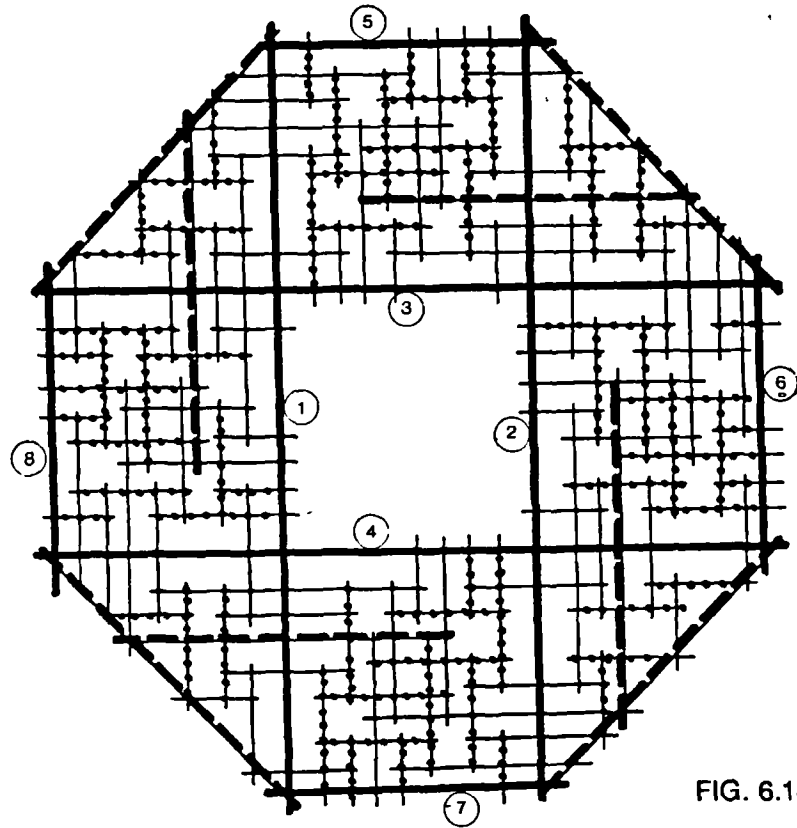


FIG. 6.18

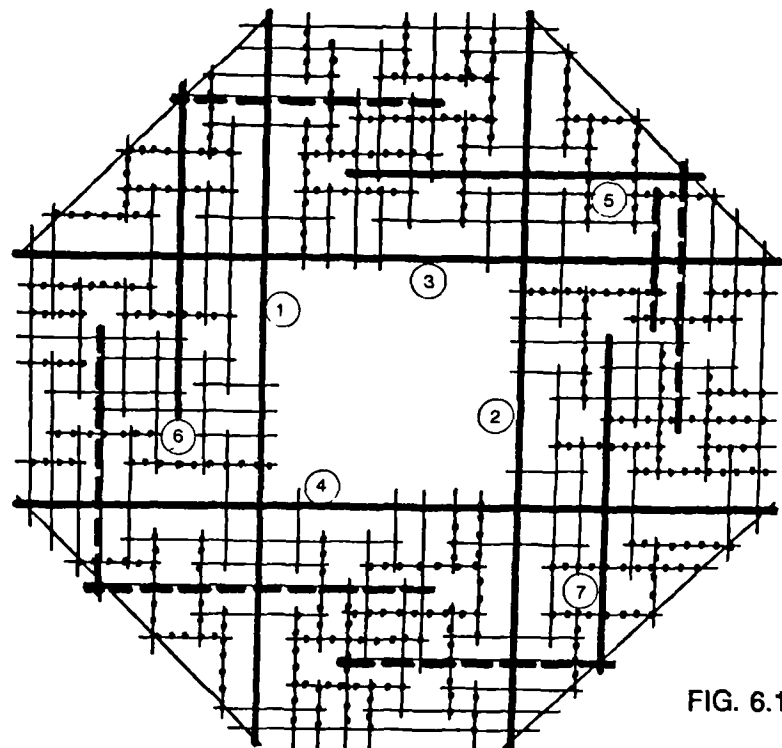


FIG. 6.19

ABADLA

—
....

INTEGRATION CORES

10% of most integrated lines

50% of most segregated lines

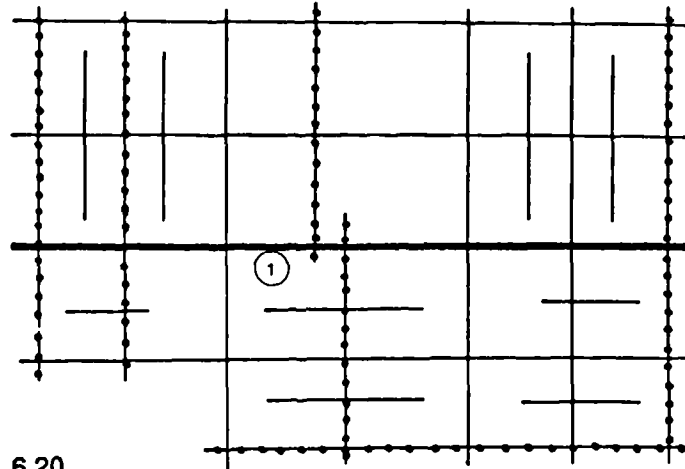


FIG. 6.20

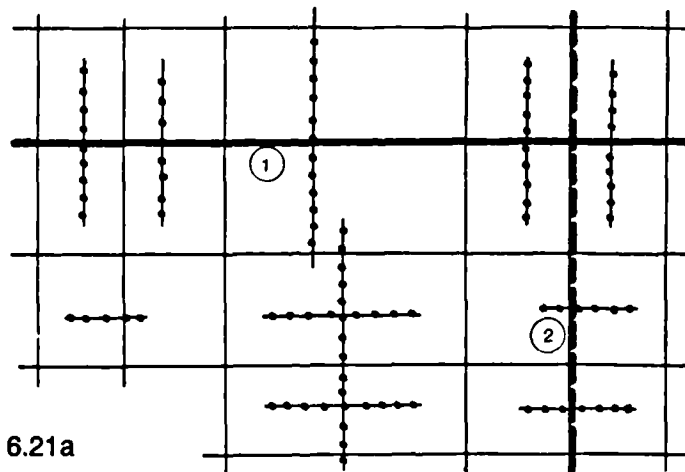


FIG. 6.21a

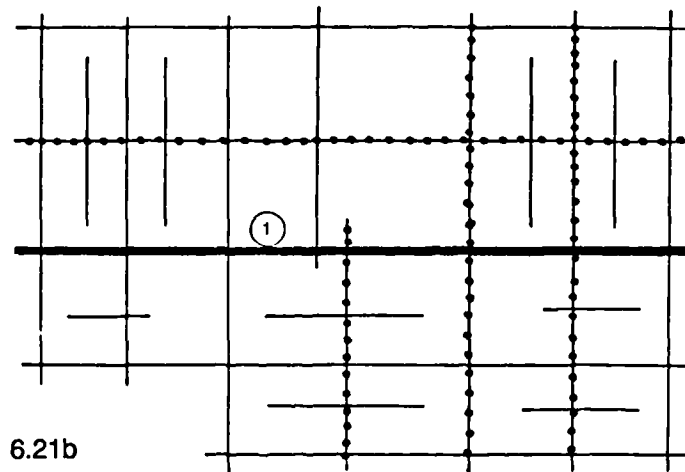


FIG. 6.21b

SAADA

INTEGRATION CORES
 10% of most integrated lines
 50% of most segregated lines

peripheral spaces and lines crossing the residential compounds. In the system analysed with the dead-ends, the integration core is constituted by two lines, one directly linking the public square which accommodates the public facilities to the outside; the other running across two residential units (see fig. 6.21a). The most segregated spaces include all the courtyards from which access to houses is gained. When the peripheral streets are omitted, the integration core does not change from the other versions, but the most segregated spaces concentrate more on one side of the system and inside the residential units (see fig. 6.21b).

Clearly, the spatial analysis of the grid of the 7 layouts has shown that the modern housing schemes are far from resembling to the structure of Arab towns. Although said to be based on traditional patterns, the newly developed layouts are creating a totally new system of urban form, characterized by a clear fragmentation of the urban space into isolated aggregates and an unconstituted grid. The examination of the integration cores of the 7 modern layouts has shown that these are made of long lines crossing in several cases the whole site in one single step. These lines which correspond to either the main central axis or peripheral roads, run in a straight fashion away from building entrances. Clearly, the spatial arrangement of these layouts lacked structure between the two poles: the outside and the residential enclosures, which are linked by a simple sequence of empty and long streets running along blank walls. The most segregated spaces on the contrary correspond to the cul-de-sac passages and communal courtyards. These segregated spaces onto which open houses form isolated clusters resulting from the fact that dwellings are organised in almost all cases into distinct small

introverted units, all at various degrees of enclosure. Because of the inward-looking character of these residential units, the surrounding roads develop mainly along blank walls. The constituted spaces on the other hand, which never form a continuous structure as they correspond to front door spaces, are bounded in a special way to mark the category of semi-private from the public space. This distinction can be easily seen in the basic axial organisation of these layouts, which consists of an orthogonal grid developing around the dwelling units and connecting to the outside, and of shorter lines developing inside the residential clusters which become more broken up as one approaches the front door of the houses.

If the strong axuality of the system of open space (i.e., roads for vehicular traffic) may be seen to be geared towards establishing the relation of the inside of the scheme to its edges, and the structure of enclosed spaces (i.e. communal courtyards, cul-de-sac alleys) geared more towards the internal organisation of the residential units, then it can be assumed with respect to the structuring of spatial relations that the axial dimension could be seen to organise more the relations between the inhabitants and strangers and the enclave organisation to order the relations among the inhabitants. This implies that in the housing schemes under study, the communal courtyards which are also the most segregated spaces, might be seen to order the relations between the inhabitants by reproducing spatial categories and dictating their interface; while the more axially developed spaces which run outside these residential units, using the spatial evidence alone, to correspond to the routes that are likely to be followed by the strangers and the inhabitants of various units. These roads which are left unconstituted, uncontrolled and separated from the communal

courtyards, are marked by a drastic "no-man's-land" effect. This model of spatial structuring can be seen then as geared not only towards distancing the inhabitants from each other, but also towards reducing their control over the street by locating the strangers in unconstituted areas. What it comes down to in these modern housing schemes is that first, there is an exclusion of strangers from the communal courtyards (or the semi-private domain): the residential units are in almost all cases segregated; and second, there is a mutual exclusion of groups of inhabitants from their respective communal space: the housing units have emerged from the analysis to form segregated clusters with respect to the whole system, but also separated from each other. To sum up, the popular enclave design principle adopted in the modern version of traditional urban forms, comes down to one basic idea: separation of social groups and fragmentation of open space. The enclave design principle works then in favour of deconstituting the streets from building entrances and distancing the users from each other, and reducing the control of the inhabitants over a large part of the street system.

The conceptual limitations of this design approach in Arab countries may be better understood in the context of a broader framework of the notions concerning the relation between social structures and spatial forms. Many studies on Arab towns have been concerned with the apparent correlation between spatial organisation and the patterns of social relations. This is mainly due to the distinctive spatial arrangement of the towns, especially the presence of quarters and dead-end passages in street configuration, both interpreted to be physical boundaries separating areas of differentiated social activities. In other words, the cohesiveness of social structures in

these systems is seen to be based on a hierarchical organisation of homogeneous groups whose global stability and integration is maintained by formal spatial ordering. Therefore, the main argument seems to have been worked within distinct assumptions about the notion of social control and the importance and primacy of urban space in generating and maintaining stable patterns of social relations. The implication of these notions on design can be traced in the development of an entirely abstract argument, using a diagrammatic representation to illustrate the implied mechanical and simplist relationship between social and spatial organisation. In this context, the emerging socio-spatial typology can be seen as a means advanced to preserve an ordering of social relations by virtue of a correspondence between segments of society and the enclosures of the settlement configuration (Fathy H., 1973, pp. 69-71). Therefore, the distinction between public, semi-public and private spaces by the introduction of physical boundaries is seen as essential not only to the well-being of the community, but also to the creation of a cohesive social order.

At both levels, descriptive and prescriptive, the privacy concept and its associated enclosure principle has been used as a means to provide some practical explanation of the relationship between social order and spatial patterns. The analysis of modern spatial layouts, has shown that these failed to reproduce spatial properties of the traditional urban forms. It is clear that the distancing of the residential areas from the more public domain in the traditional towns results from an overall level of grid deformation, not by clustering spatial units, dissociating the houses from the streets and fragmenting the open space structure. Therefore, the privacy

requirement and its associated "enclave principle" can, one suspects, be identified more as an exercise in legitimising and justifying the use of "rationality" in design activity than a fundamental characteristic of Arab towns.

The structure of ideas underlying this design approach can be traced in the first instance, to the argument which suggests that there exists social needs or functions which must be understood and decomposed into variables by analysis, and the task of design becomes that of re-organising the form by drawing a synthesis in such a way as to satisfy the functions. This belongs to the functionalist tendency in architecture which, as Hillier puts it, promotes the belief that the form taken by a building or a town is essentially a "function of something else; of climate, technology, or social requirements" (Hillier B., 1987, pp.207-208). Alexander's "Notes on the synthesis of form" is an example of this approach, in which he defines design "as the process of inventing physical things which display new physical order, organisation of form in response to function" (Alexander C., 1964, p. 1). Elsewhere, using the same idea he writes:

"Each zone, through its formal clarity and integrity, induces, reflects and sustains the activity it has been designed to serve" (ibid, 1977, p. 82).

The whole argument is that a proposed type of physical arrangement is considered acceptable only if a pattern of needs can be fulfilled efficiently. In this respect, Hillier argues that the theoretical implications of this approach can lead to "a dangerous idea that architectural form is only a function of something outside itself, and

to understand it one need only to understand the social, economic processes which give rise to it..." (Hillier B., 1987, p. 207).

The functionalist approach seems in reality to be more needed by the architectural profession, mainly because it serves as a knowledge basis on which designers make proposals and thereby establish a strategy for the acknowledgment of their expertise. Since the 1920's, the functionalist approach has dominated the architectural ideology and has always provided a methodological basis for practical design activity without however, providing any real guidance of how to arrange the fit between form and function. "Form follows function" central to functionalism, provides thus the basis for generating design solutions and a way to talk about the fitness of these solutions.

In this design approach, there is a clear emphasis and more investment in the design procedure, such that how to arrive to a given form rather than how this proposed layout will tend to perform. In this respect, Blake argues that this approach persists today in spite of the severe criticism based on the accumulated evidence of its inadequacies both as a design theory and a research paradigm to deal with the problems of urban design (Blake P., 1979).

In the context of the housing layouts under study, the whole design process is said to develop from the initial description of users' needs including the social need for privacy, which then are translated into a suitable building form. For example, Lesbett in his description of the process of production of new villages in Algeria, states the various stages, the primary one being the socio-economic survey which is

designed to identify and assess the social needs of the future population of the village (Lesbett D., 1983, p. 138). By focussing first on the definition of the users' needs, the design process paradoxically hinders its major goal. It is, according to Steadman, the Darwinian notions of biological evolution which were

"conducive to a belief in functional determinism in design: it removed the designer, it encouraged an exclusive attention to utilitarian functions and it suggested that designed objects were the product of selection exercised by their functional environment" (Steadman P., 1979, p. 205).

From the preceding discussion, it is clear that the nature of the problems faced by designers resides in firstly, the difficulty in obtaining "objective" knowledge from existing forms that can be related to social parameters. That is, the problem has its roots in the difficulty to define a relationship between the material result of architectural production and the abstract realm of social relations. According to Hillier and Hanson, "to remedy this, two problems of description must first be solved: social structures must be described and understood in terms of their intrinsic spatiality; and spatial patterns must be described in terms of their intrinsic sociality" (Hillier B., Hanson J., 1984, p. 26). Secondly, the difficulty of relating local dimension of urban forms to their overall structure; and finally, the difficulty of establishing a dynamic design process in which the knowledge gained by analysis can be continuously embedded and re-embodied in design solutions.

In view of this emphasis in defining the problem, the recent work of Krier on design theories based on existing forms appears at first

suggestive. Krier has attempted to develop an overall self-contained design theory based on the study of historical precedents and their effective use in future projects. According to Krier, the contemporary problems of urban space reside in the lack of more serious studies of the history of town planning. He argues that the essence of the problem of urbanity has been solved well before the industrial revolution, and proposes a re-construction of the open space of the city, using two elements which he considers as the basic forms of urban space. These are the square and the street, which can be according to him, combined in an innumerable spatial patterns in order to reproduce the qualities of urban space (Krier R., 1984, pp. 19-34). Spatial types and the geometrical characteristics of urban morphology are, according to Krier, the main objective qualities of urban space. These forms can be then derived from three basic shapes: the square, circle and triangle. Following this typology, Krier suggests an encyclopaedic analysis of possible element configurations, particularly squares and circuses, in an attempt to arrive at a categorisation of urban space. These elements are then reapplied as type-solutions in the reconstruction projects (ibid, p. 89). However despite his claims, this analysis of urban space seems, from a methodological point of view, problematic mainly because it is preoccupied to create a global picture of the city only from the consideration of its various individual elements, and as such it fails to consider the urban space as a system.

This attempt to identify the essential components of existing cities and their classification, is similar in intention to Lynch's analysis, and also to Camillo Sitte (Sitte C., 1965). Lynch offers five categories of urban elements, which are more conceptual than

concrete (paths, edges, nodes, districts, landmarks), without however giving any indication on how these abstract components may relate to each other to form the whole pattern. Lynch has recognized himself the fact that most of his work was dedicated to the identification and structure of single elements without a proper study "directed towards a synthesis of the city form considered as a whole" (Lynch K., 1977, p. 118).

Therefore, these design approaches have been limited by an absence of a formal system with effective rules of association of the single urban elements they define. Such disregard for the importance of the overall structure and circulation patterns of the city may be the fundamental cause for the problems of urban design today.

In fact, what is being discussed seems to relate to a more general question of architectural knowledge that is supposed to be retrieved from existing forms. More precisely, the problems faced by designers seem to be intimately related firstly, to the nature of the retrieved knowledge and the way in which such knowledge is gained; and secondly to the means by which the retrieved knowledge is then re-embodied in new design solutions. In other words, the problem of design seems to be fundamentally related to the problem of description.

In this respect, Hillier argues for the need of a morphological approach to the field of urban studies in which the primary focus should be the urban form itself, its nature, its origin and the different patterns it acquires. He argues that a morphological approach based on a theory and method of description would provide

the foundations to conceive "the possible out of the study of the actual" (Hillier B., 1979, unpublished paper). This implies a decisive shift from the study of procedures of design into the study of the built form and the end-product rather than the means. He writes:

"If we could discover how collections of buildings, added in a sequence to a growing aggregate, appear to produce their own order, then clearly something like a more organic environment might be reconcilable to the necessity for planning and design to ensure movement of traffic. Design would be more concerned with implementing genetic programmes than with the total design of environments" (Hillier B., 1979, unpublished paper).

The application of morphological approach to the study of a large number of towns and urban areas at the Unit of Architectural Studies has shown empirically how spatial structures relate to the patterns of movements; it has shown that the underlying spatial structures of urban forms create and restrict encounter fields and that the structure of these fields relates to the type of social relations. Such studies stemmed first of all from the theoretical stance of the notion of structure in space, defined as the outcome of restrictions on an otherwise random process of building aggregation; and these restrictions are seen as analogous to social relations and activities (Hillier B., Hanson J., 1984, pp. 10-14). Hillier has explored this conception of order by developing a generative model, designed to account for a particular spatial structure observed in a set of hamlets in Vaucluse in south of France. He found that by aggregating open to open cells (representing the threshold of buildings), but randomising the location of closed cells (representing the buildings), the outcome of such a process approximates the spatial form found in

the real examples. This conceptualization of an urban order sheds some light on both the relationship between the local dimension of a town and its global form; and the relationship between spatial patterns and systems of social relations. In the first instance, Hillier has shown, using manual experiments and computer modelling, how a global form of self-generated settlements can arise from the application of purely local rules imposed on an otherwise random process of aggregation (ibid, pp. 60-61). These rules form the generic structure -hence the constitution of the town form through the relations of its components- or what Hillier calls the "genotype" which defines the relations between the individual elements of the urban fabric, as opposed to the "phenotype" or the particular morphological outcome. Such distinction is basically one between an actual existing form and its underlying rules. In such structures, the genetic structure or genotype, would be invariant and the actual phenotypical outputs would be different in each case.

By showing the existence of a "genotype" underlying a set of existing towns, then it can be argued that some kind of cultural principles for giving different social relations and activities a spatial form with respect to a whole complex of spatial relations, has been identified. In all cases, the precise pattern can usually be specified by adding extra structural information into the "genetic programme", which as a result becomes longer in the sense that more generative rules must be prescribed in order to arrive at the generation of a particular settlement form. For example, Salah-Salah, while investigating the occurrence of an urban phenomenon in some towns in the Sahara desert, generated a sample of systems by adapting the generative syntax model initiated by Hillier, and by introducing some extra rules

and constraints, such as the variation in the size of the elementary cells, "overlap" and "sliding" rules (Salah-Salah F., 1987, pp. 299-305). The results of the analysis of these systems (see Table 6.4, below) generated on the basis of a localized process, that is following a cell growth process without any of the globalizing tendencies which have been shown to be critical in the 7 modern layouts showed some similar spatial properties to the 12 traditional towns under consideration.

MEANS OF	CN	RRA	1:RA/CN	1:RA/RCH	CN/CH
MEAN (r:K)	2.646 (0.043)	1.509 (0.623)	0.449 -	0.725 -	0.670 -
MAX. (r:K)	5.971 (0.388)	2.014 (0.560)	0.716 -	0.873 -	0.843 -
MIN	1.943	1.107	0.209	0.579	0.475
r:K	-	-	(-0.630)	(-0.340)	(-0.507)

TABLE 6.4: MEASURES FOR THE 70 COMPUTER GENERATED SYSTEMS(*)

In line with this, the following section opens up a discussion on how a retrieved description corresponding to the "genotype", from the actual towns under study can play an instrumental role to conceive and design new housing layouts in the present cultural context. In other words, it will be shown how morphological studies may be useful in the design task.

(*) Source: Salah-Salah F., Ph.D thesis, 1987, p. 343.

The basic argument is quite simple. The urban morphologies generated by Salah-Salah (urban only in the sense that the result was a set of islands of cells surrounded by a continuous open space) have shown similarities, both in terms of numerical properties and global structure to the towns under study. Although initially not conceived to serve a design purpose, the study attempts to use these models as a base map for housing layout design, in order to test an alternative design process of a modern version of "traditional" housing arrangement where it is suggested that firstly, the global structure would be intimately bound up with the building mainly because it has evolved from the application of a non-global process; and secondly, the spatial pattern of the layout would be then held to present an intrinsic social dimension. What this means, is that design activity becomes strongly dependent on the study of existing forms from which description can be retrieved at both levels analytic and generative. In other words, analysis becomes more instrumental and the designer's task is no longer concerned with finding a suitable form to satisfy a set of users' needs, but more with continuously re-embodying the acquired knowledge into design-solutions.

As an application of such a process, the following section will attempt to present two examples, using the generated morphologies as a basis or a kind of backcloth for the road structure and parcellation. The proposals will also aim to fulfil the requirements of the brief used for the design of the 7 modern layouts presented in this chapter, the schedule of accommodation, and the social requirements for the location of the public facilities, using surveys conducted on these systems. A summary of the brief used in the design of the modern layouts is inserted in Appendix 3. The proposed

schemes are then analysed and discussed in terms of spatial hypotheses set up at the beginning; new adjustments are then made and a new analysis is carried out and so on. By presenting proposals, the main intent is to illustrate the process advanced here and assess its "feasibility" in using instrumentally retrieved description in design.

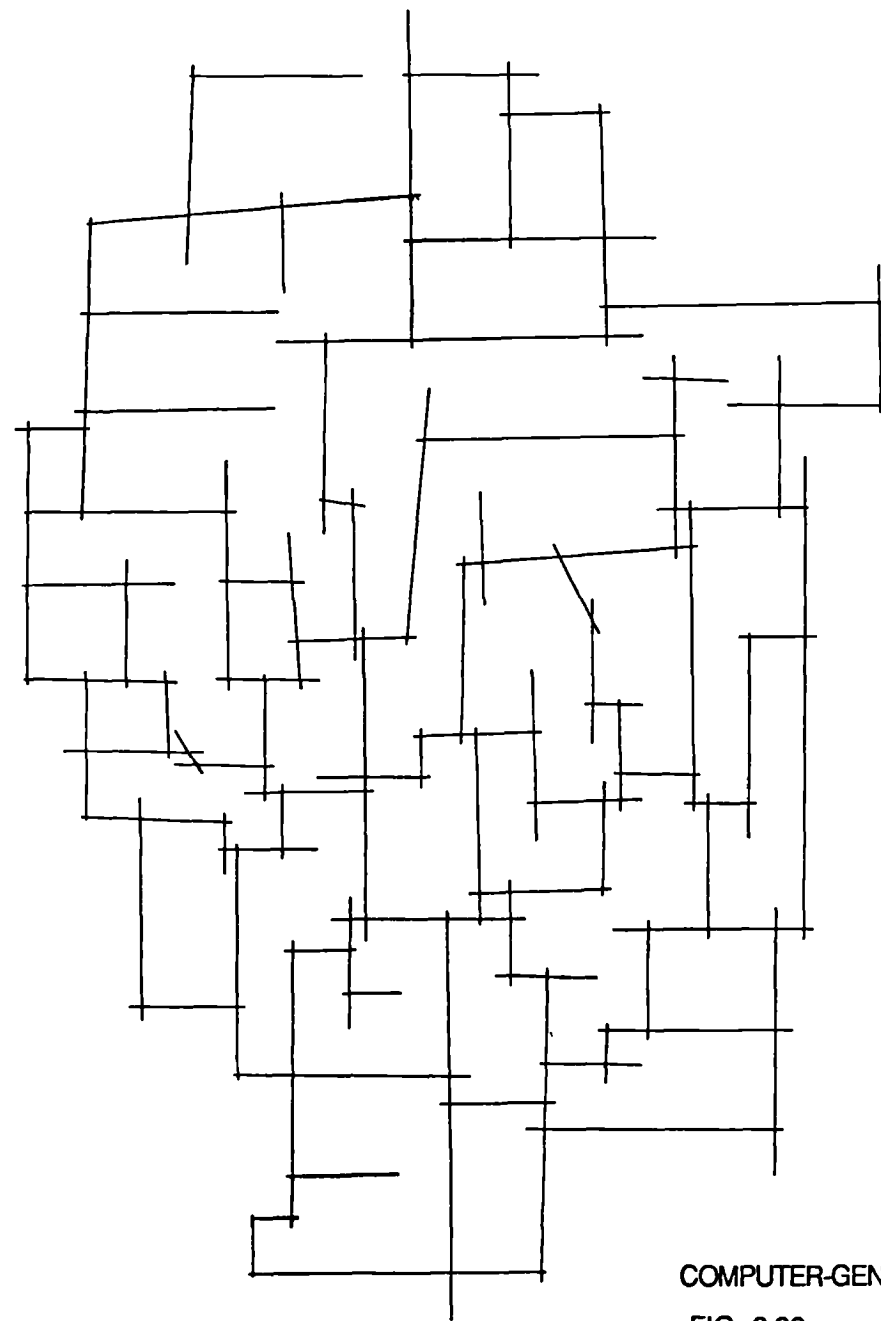
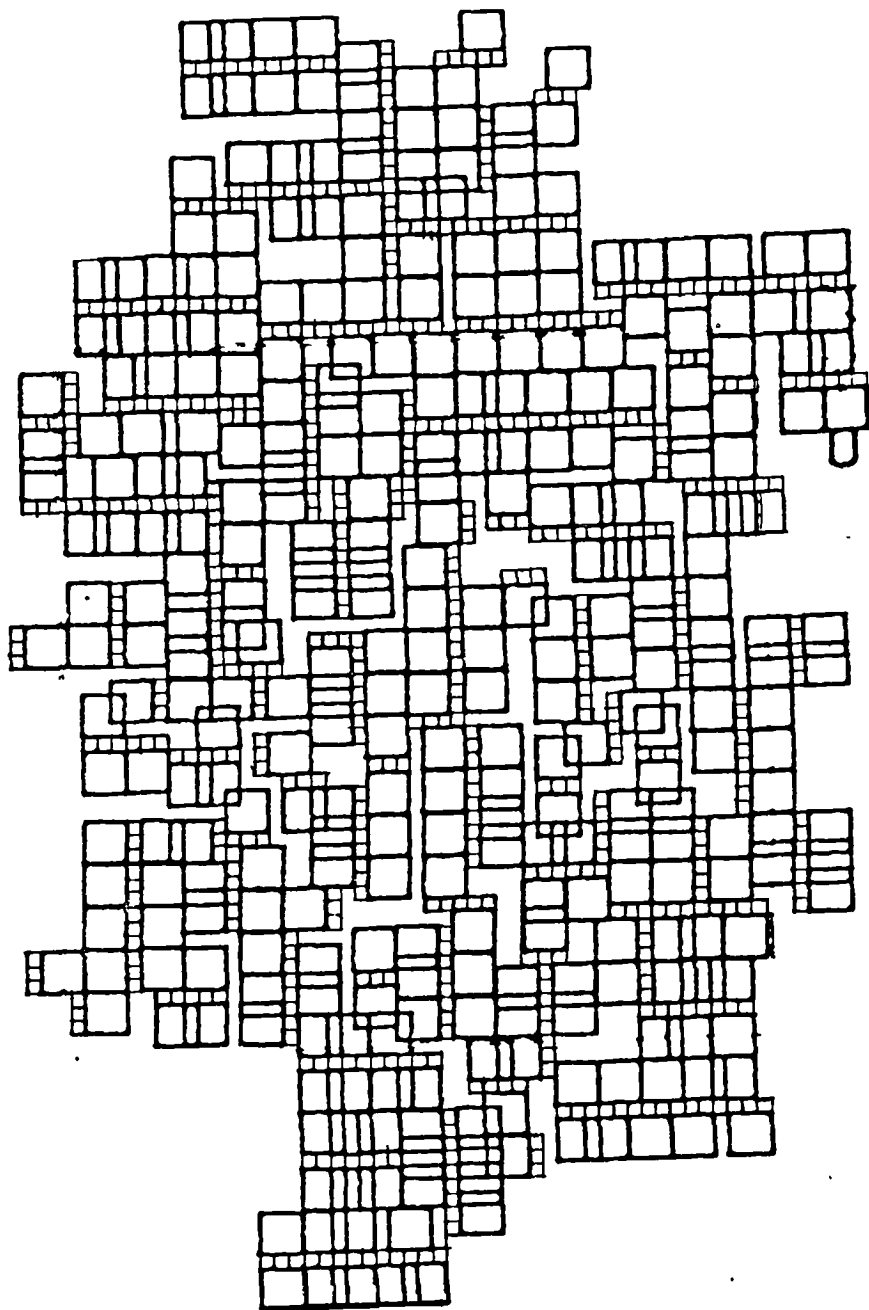
PRESENTATION OF THE PROPOSED SCHEMES:

The selection of the generated morphologies to be used in the proposed schemes has been done according to three main criteria:

First, the number of closed cells representing the houses, which according to the brief determines the type of facilities. The spatial system must also present dense blocks of reasonable size with a fairly continuous structure of the open cells.

Second, the type of integration core of the generated systems. In the following schemes, it has been decided for the first example to use a system with a linear and traversing core and in the other example a more internal and clustered type of integration core but in both cases they link to the outside, in order to explore the design choices as defined by the overall spatial structure of the layouts.

The first selected computer-generated system shown in Figure 6.22a contains 340 units and has a linear integration core which runs in the middle of the morphology and links on one point to the outside. The proposed scheme will have then public facilities of a "Type Two" settlement. The second system is smaller and contains only 240

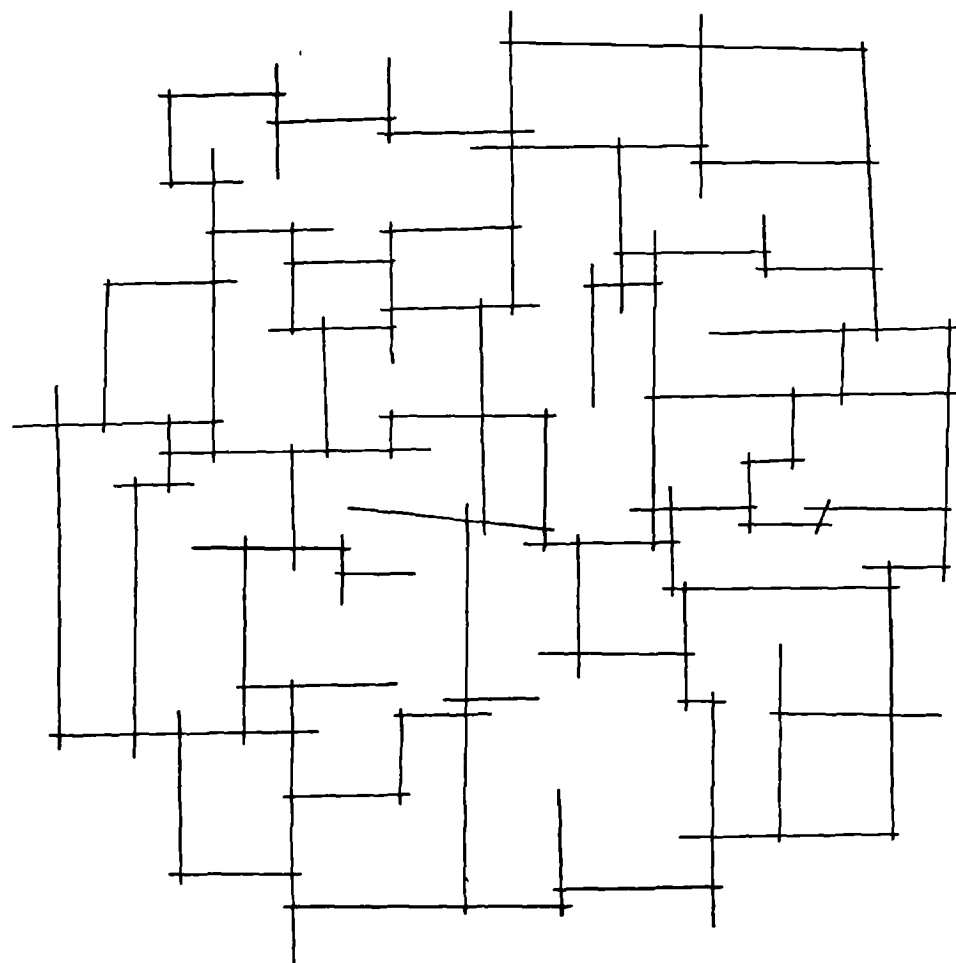
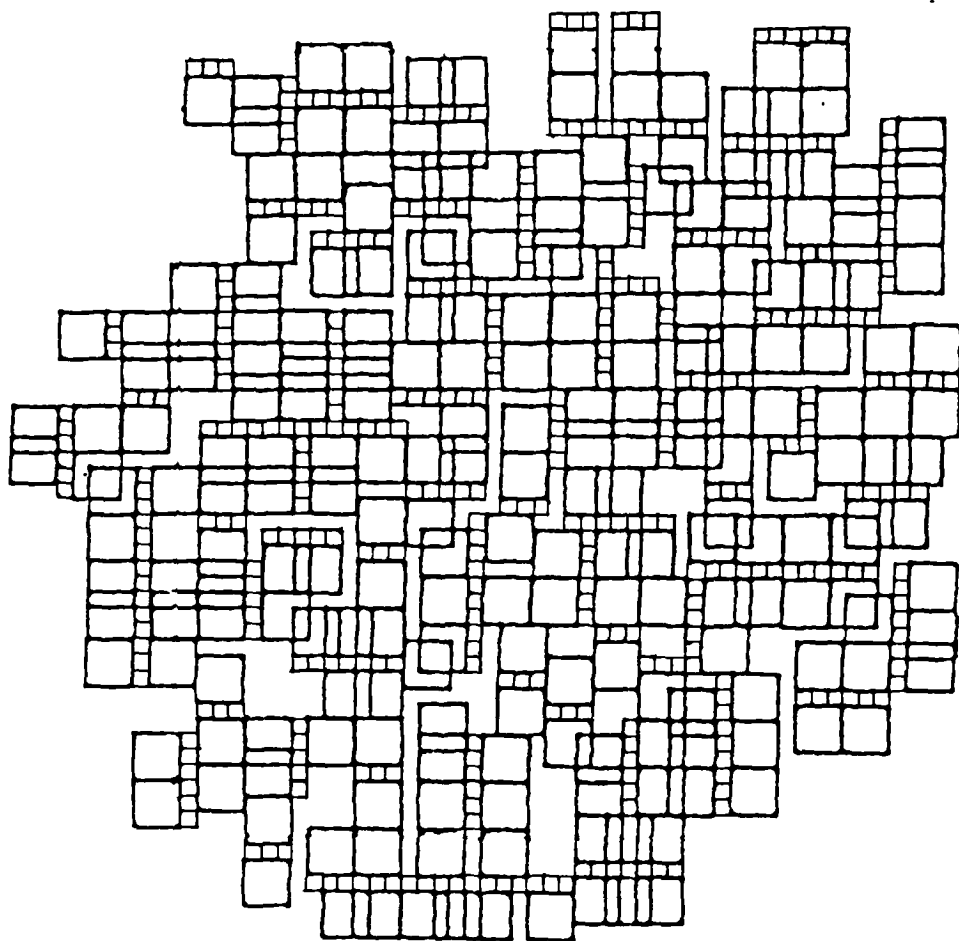


COMPUTER-GENERATED SYSTEM

FIG. 6.22a:





Closed cells
Open cells



421

COMPUTER-GENERATED SYSTEM

FIG. 6.22b:

 Closed cells
 Open cells

units (see fig. 6.22b) and presents an internal core type with no strong connections to the outside.

The first difficulty encountered in this design exercise is the introduction of "scale" or a metric dimension into the computer-generated system. The right of way of the access roads and the average size of the plots given by the brief have been the only guidance. In the generated systems, there is a dimensional relation between the size of the open cells (1x3 units) which make the streets and the closed cells (3x3 units) which make the housing stock. To overcome this difficulty, a series of exercises, by trial and error, have been conducted on an enlarged version of the generated systems, in an attempt to arrive at a scale which satisfies both, the required size for the roads and the house plots.

The second task in the design has been to distinguish between the main road (or roads) from the access roads as these have different right of ways. This has been done using the integration structure of the system. The roads which form part of the integration core have been designated as the main roads and therefore in formal terms, their right of way will be 8 metres. In addition, some adjustments have been introduced in the road structure. For example, more direct links of the "core" roads to the outside have been sought. Other adjustments of the "core roads" were concerned with junctions (i.e., staggered junctions have been replaced whenever possible, by cross-junctions); while some streets were reserved only for pedestrian use, but every plot in the layout has a direct access from a road for vehicular traffic. Road curves were adjusted and designed according

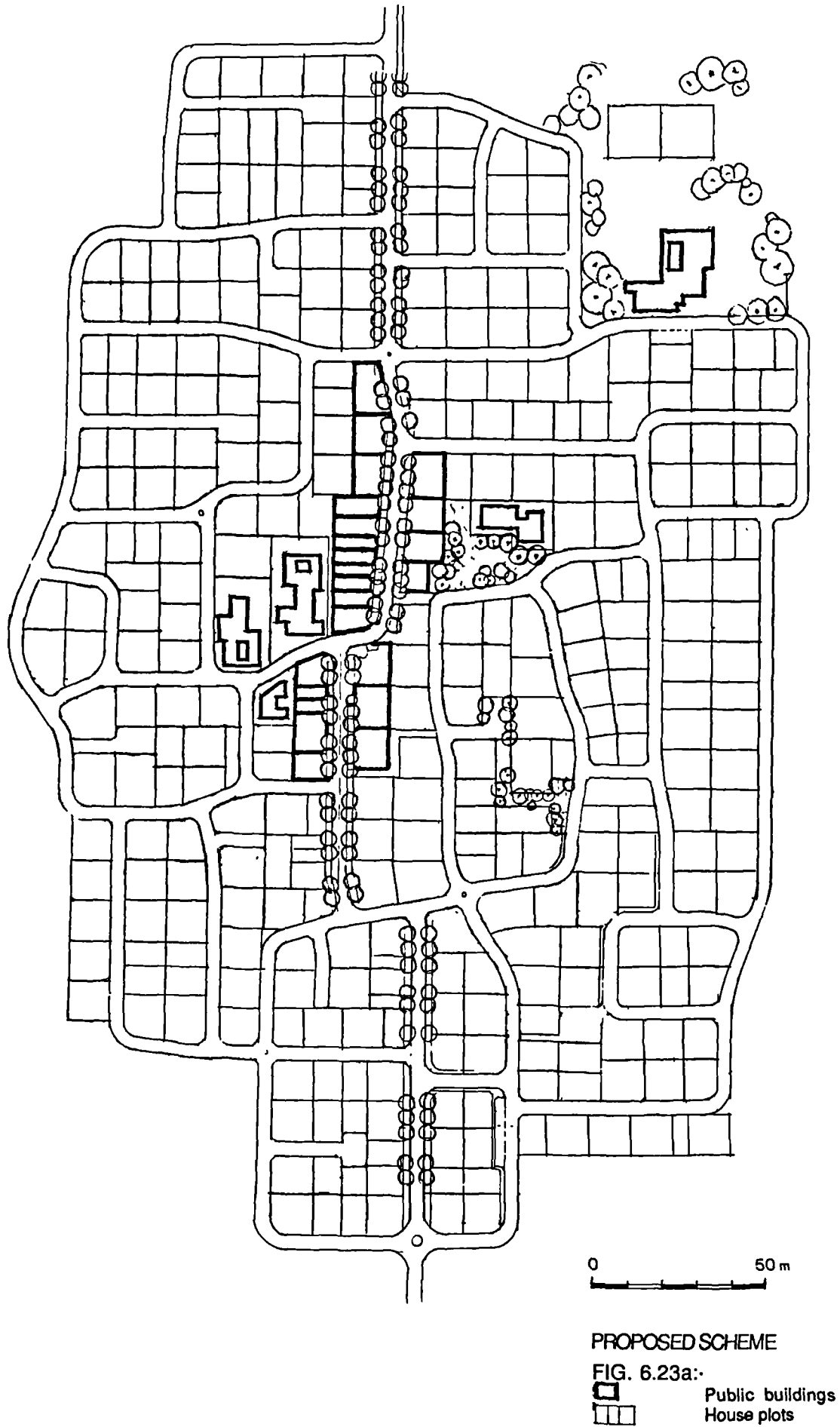
to the highway standards, and links were also made continuous between roads that are separated by only one single closed unit.

An axial map has been prepared of each of the final schemes and an analysis carried out, prior to the distribution of the public facilities. More amendments have been added in order to improve for example, the connections of the "core roads" to the outside. The public facilities, including the landscape of the streets and open spaces, are then located on the layout, using as guidelines the requirements of the brief (see Appendix 3).

The final layout of the first example is presented in Figure 6.23a, and some physical characteristics can be outlined. The layout covers an area of 6.25 hectares (62500 m²) with the roads representing 28% of the total design area. This gives a net density of 77 houses per hectare. The size of the blocks of houses varies from 380 m² to 3130 m². The second layout (see fig. 6.23b) covers an area of 7.4 hectares, with roads taking 31% of the total area.

A spatial analysis of the final proposals has been carried out and the results are summarized in the following.

- The mean connectivity of the two proposed layouts (2.9647 and 2.8537) approaches the mean of the 12 systems taken as a group (3.076). The mean integration of the proposals (1.1785 and 1.2489) is much higher than the mean of the 12 towns (1.421). In fact, the mean integration of the two proposed layouts is very close to the mean integration of Sale (1.1852) or Tunis (1.298) and Susa (1.272).







0 50

PROPOSED SCHEME

FIG. 6.23b:

 Public buildings
 House plots

- The proposed layouts have also a very low relative intelligibility (-0.2431), but an average movement interface (0.79 and 0.81). The proposed schemes have also shown a low local predictability (0.63 and 0.64) and interface potential (0.48 and 0.46).

The above numerical properties point to the conclusion that the proposed layouts present in many respect, strong similarities to some of the spatial properties of the towns under study.

For the first scheme, the integration core in Figure 6.24a takes a linear structure, continuously linking the central part of the scheme to the outside. The core does not traverse entirely the system, and resembles the core of Wargla. But the core of the second scheme (see fig. 6.24b) is constituted by a dense cluster of integrated spaces located in the central area of the system and connected, on one side only, to the outside. The core does not traverse the system and in this respect, resembles the core of Sale. As already pointed out earlier, the location of the public buildings such as the mosque and the shops, has been determined in accordance to the positioning of the most integrated spaces. The most segregated spaces of the two schemes, on the other hand, develop around the integration core, on the edges of the scheme.

The strong choice lines of the first scheme in Figure 6.25a form also a linear structure, running in the centre of the scheme and linking to the outside. The choice structure overlaps strongly with the integration core, with the most integrated space remaining also the best in terms of choice. For the second scheme, the strong choice lines in Figure 6.25b form as in the previous layout, a linear pattern

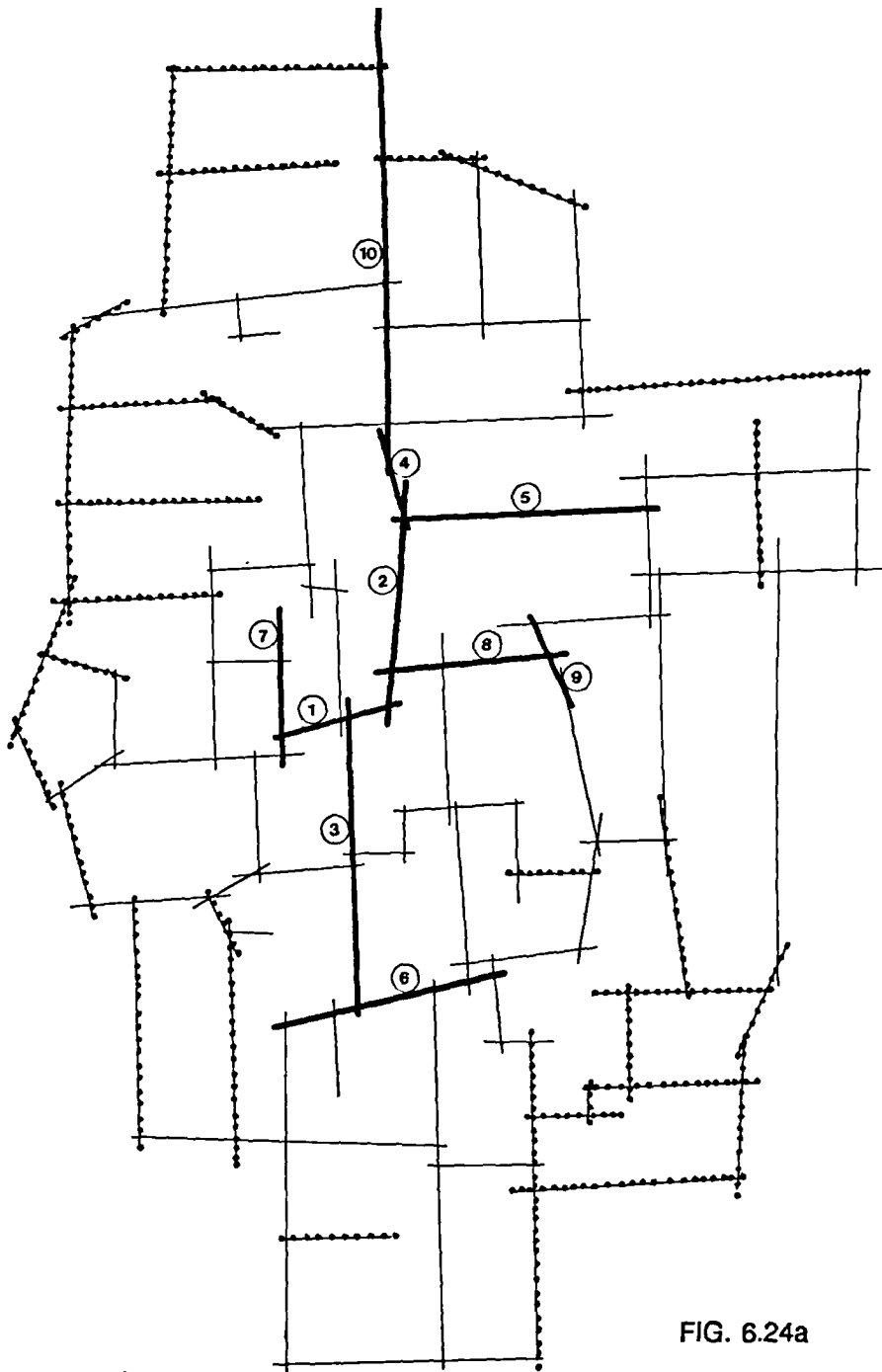


FIG. 6.24a

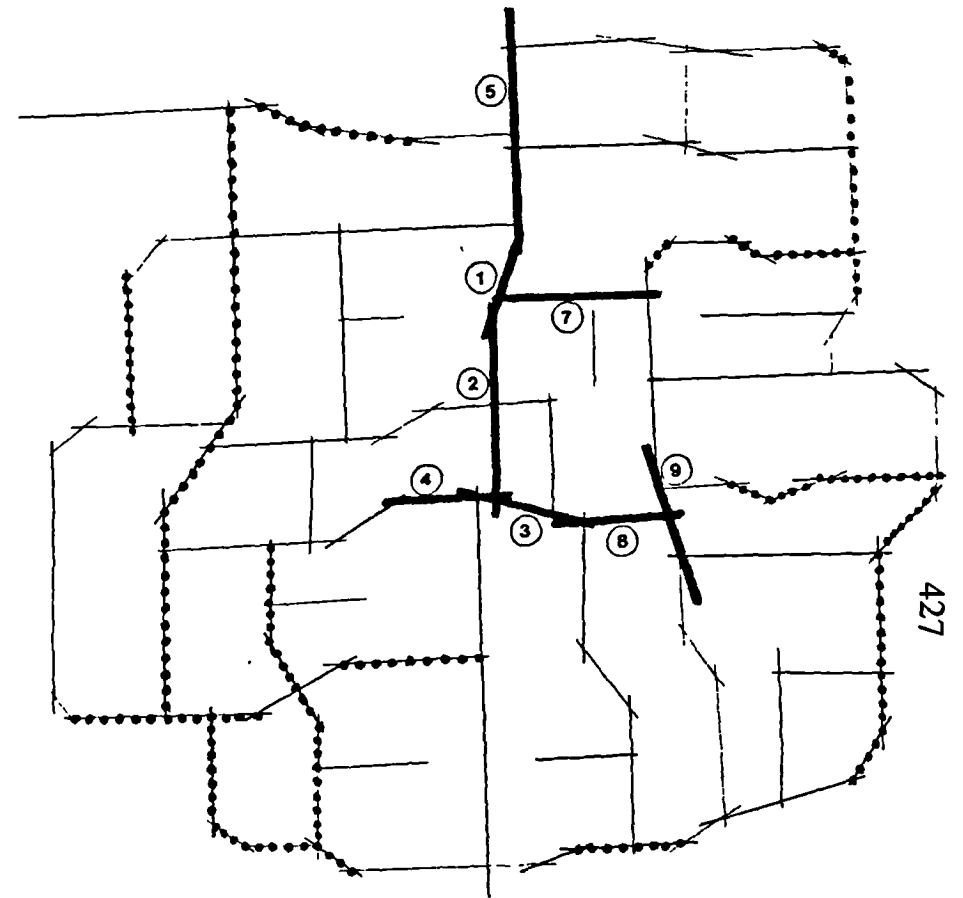
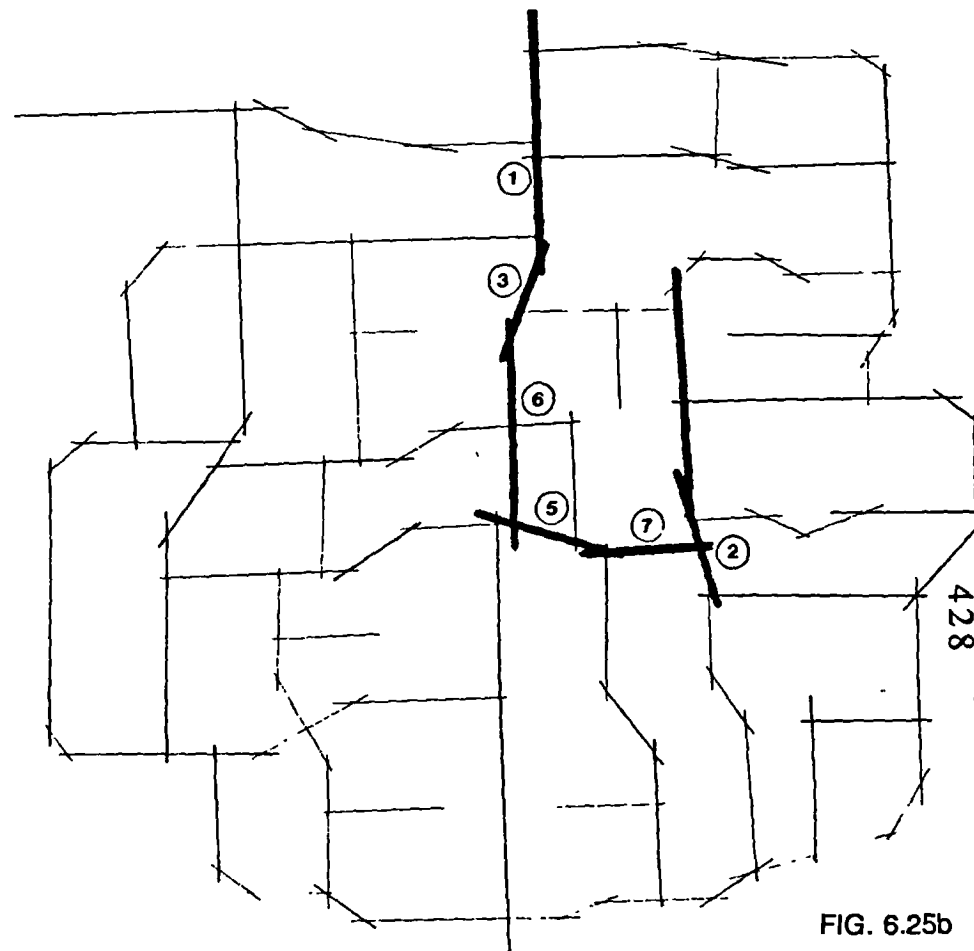
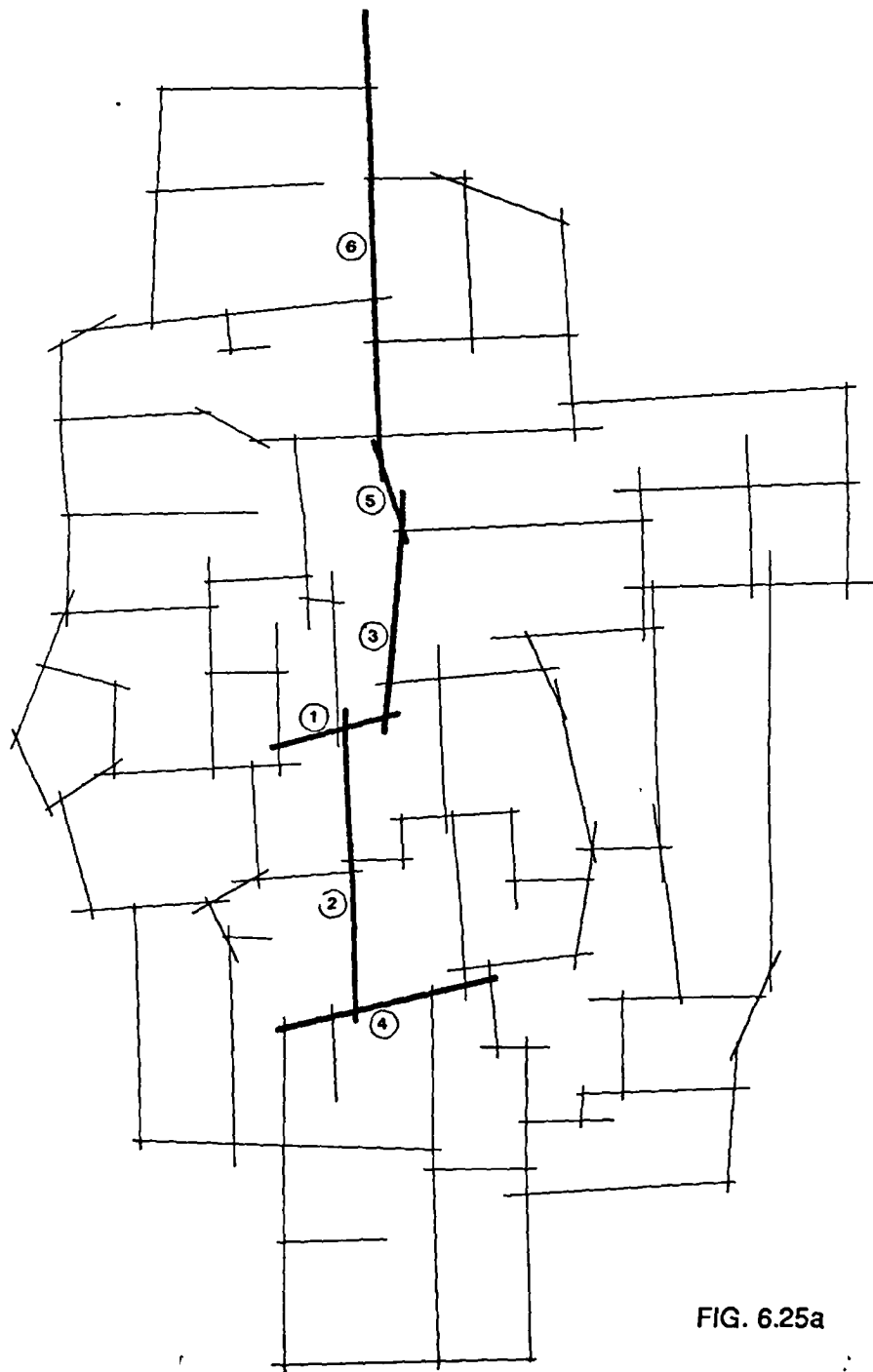


FIG. 6.24b

PROPOSED SCHEMES
INTEGRATION CORE

— 10% of most integrated lines
.... 30% of most segregated lines



PROPOSED SCHEMES
CHOICE STRUCTURE
 ————— 25% of choice quantities

strongly connecting the interior to the outside. In this scheme, there is also a strong overlap between the best lines in terms of integration and choice.

Therefore, the proposed schemes have also shown some similarities to some of the towns under study in terms of their global structure. The schemes presented a clear regionalization in their global structure, with a core-type confined to one "region" and not expanding to cover the whole system. By this, it has been shown that "privacy" and the distancing (if required) of the houses from the main activity area, can be achieved through the global structuring of the town grid rather than the local clustering of housing units. The above proposed examples of housing schemes have shown how the concept of "grid deformation", that is the "quasi-labyrinth" type of grid can be used as a principle of design. The application of a design task which proceeds from "global-to-local", while at the same time initiated from "local-to-global", guarantees the "local-to-global" relation at the deepest level of space construction. It has also been shown that the problem of "wholeness" or overall city form encountered in the development of modern layouts, can be dealt with not at the architectural level by designing better individual buildings, but by involving a different design process. In other words, the problem of "overall city form" cannot be solved by design alone, but must be considered in a wider framework which relates urban systems to their process of growth by which towns acquire their final form.

In conclusion, the final part of the present report has focussed on design theories and concepts which proclaimed reference to the

traditional forms of Arab towns. The spatial description of the modern housing schemes assumed to be based on traditional patterns revealed fundamental differences with these latter. This clearly exposes the limitations of the adopted "cluster" design concept and its associated over-hierarchization of dwelling units and over-separation of the public buildings from the residential area.

Therefore, what the localizing arrangement based on the cluster concept achieves in forming groups of inhabitants by increasing their spatial proximity, is suddenly lost and not sustained at the global level. Unlike the traditional form of housing which remains first of all a structure of "solids" the arrangement of which results in a particular pattern of open space, the new urban landscape appears as no more than a structure of empty open space clearly dissociated from the buildings.

The striking widespread of the above model and the position which many designers appear to have adopted suggest that the design principles have been identified as more of a justification of design activity than as a useful tool for describing the nature of spatial patterns and the way in which these might relate to social relations, or even as a design tool to recapture properties of traditional housing forms.

A first inference follows, that is the notion of control through a spatial organisation with inherent social logic presented here neither necessitates nor presupposes a hierarchical arrangement structured through the enclosure principle of the residential blocks. By contrast, the "quasi-labyrinthine" type of grid seems to allow a

"dialectic" to take place, that is the achievement of privacy requirements without isolation, high density of urban blocks without promiscuity, compartmentation without fragmentation, morphological complexity without disorganisation, a sense of community without territories. The second inference is that the understanding of the way in which towns acquire their global form through the identification of the nature of relationship between their local and global order, opens up a new dimension in the discussion of problems of a practical nature faced in design. The proposed design process remains, at this stage, conjectural and necessitates further research. But, from a methodological point of view, it illustrates an alternative way of re-embodying architectural knowledge derived from the study of existing forms in the pathway of achieving "an urban whole", to the current design practice in which emphasis is placed more upon design procedures aimed at "translating" users' needs into a suitable building form. The close match between the general principles of spatial articulation of the proposed schemes and some of the 12 Arab towns corroborates the design process advanced here and the "quasi-labyrinth" grid type as a design concept in the present cultural context. The sense of an urban whole and the way the parts interconnect to form the whole, can be formulated and used in an operational way, and as such opens up a new dimension in the dialogue between the morphological studies of actual forms and their implications in design solutions.

APPENDIX 1: DATA SOURCES

The selected sources are as follows:

Town plans:

- Tunis: Lezine A, 1971.
- Algiers: Comedor, (Algiers), 1974.
- Sale: Mil. Geo. Plan von Rabat-Sale, Berlin, Generalstab des Heeres, Abteilung Fur Kriegskarten und Vermessungswesen, 1941; Naciri M., 1963.
- Susa: Lezine A, 1971.
- Tangier: Direction des Affaires indigenes et du service des renseignements, Vol.7, 1941, Paris; Kasba 64 Study Group, 1973.
- Constantine: "Ministere de la guerre", Etat Major General, 1881.
- Meknes: Plan von Meknes, Berlin, Generalstab des Heeres, Abteilung Fur Kriegskarten und Vermessungswesen, 1941; Akcura, 1974.
- Fez: Unesco in Gaudio A., 1982.
- Kairwan: "Ministere de la guerre", Etat Major, 1881.
- Wargla: Municipality of Wargla, 1968.
- Guemar: Bataillon C., 1955.
- Tamelhat: Mangin D., Panerai P., in "Architecture, Mouvement et Continuite", 1980.

Quarter limits:

- Tunis: Hakim B.S., 1986.
- Algiers: Comedor, 1974.
- Sale: Naciri M., 1963.
- Constantine: Institut d'architecture et d'urbanisme de Constantine.
- Meknes: Akcura N., 1978.
- Fez: Kasba 64 Study Group, 1973.
- Wargla: Brigol R.M., 1973.

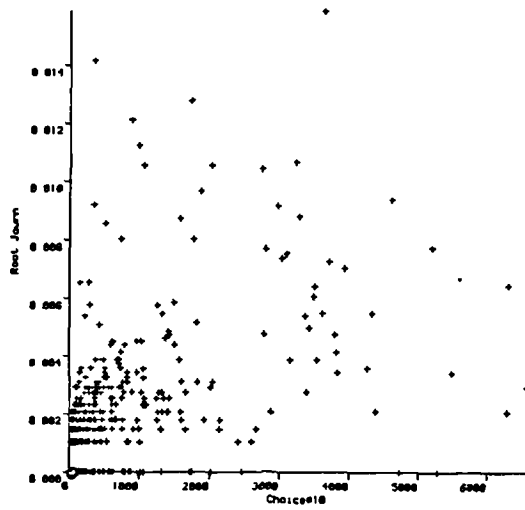
Location of key town facilities:

- Tunis: E.R.A., C.N.R.S. 706 Inst. de Geog., 1982, Tours.
- Algiers: Comedor, 1974.
- Sale: Revue de Geographie du Maroc 1981; Naciri, 1963.
- Susa: Lezine A., 1971; E.R.A., C.N.R.S. 706 Inst. de Geog., 1982, Tours.
- Tangier: Kasba 64 Study Group, 1973.
- Constantine: Institut d'architecture et d'urbanisme of Constantine.
- Meknes: Akcura, 1974.
- Fez: Kasba 64 Study Group, 1973.
- Kairwan: E.R.A., C.N.R.S. 706 Inst. de Geog., 1982, Tours.
- Wargla: Brigol R.M., 1973;
- Guemar: Mangin D., Panerai P., 1980.
- Tamelhat: Mangin D., Panerai P., 1980.

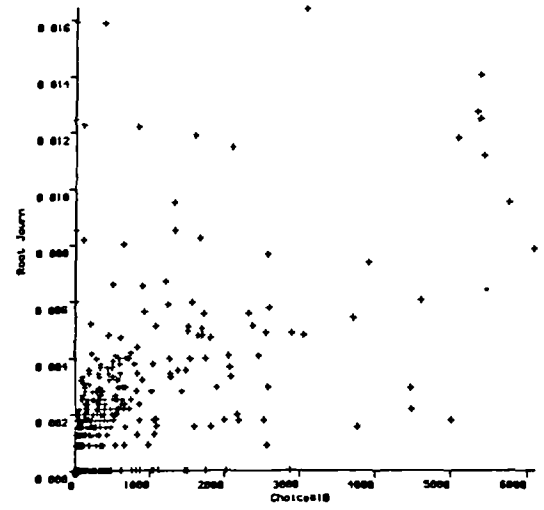
Modern housing layouts:

- Souahia: ETAU (Entreprise des Travaux d'Architecture et d'Urbanisme), Algiers, 1978.
- Mebdaoua: BET (Bureau d'Etude Technique), Algiers, 1976.
- Anouna: Technique et Architecture, special issue, June 1979.
- Amrane: ETAU (Entreprise des Travaux d'Architecture et d'Urbanisme), Algiers, 1978.
- Damous: Technique et Architecture, special issue, June 1979.
- Abadla: AAU (Atelier d'Architecture et d'Urbanisme), Algiers 1978; Technique et Architecture, special issue, June 1979.
- Saada: BET (Bureau d'Etude Technique), Algiers, 1976.

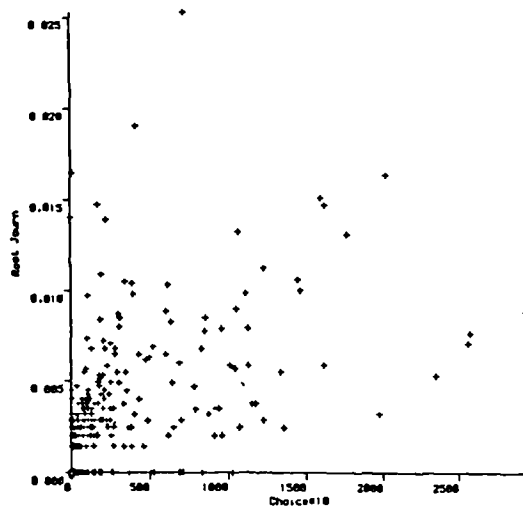
APPENDIX 2: SCATTERGRAMS FOR THE 12 TOWNS OF CORRELATION
BETWEEN CHOICE AND RANDOM JOURNEYS FROM THE
OUTSIDE



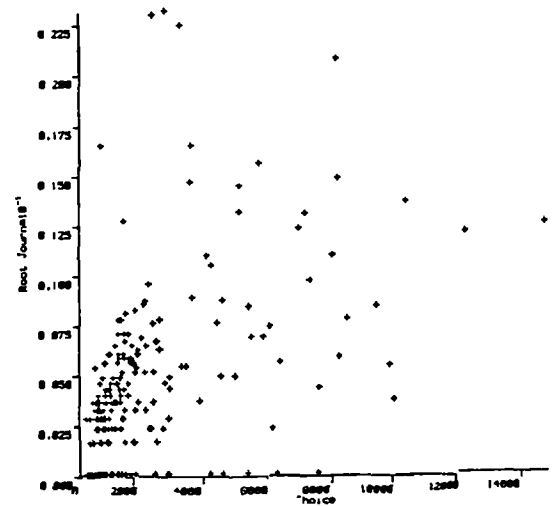
TUNIS



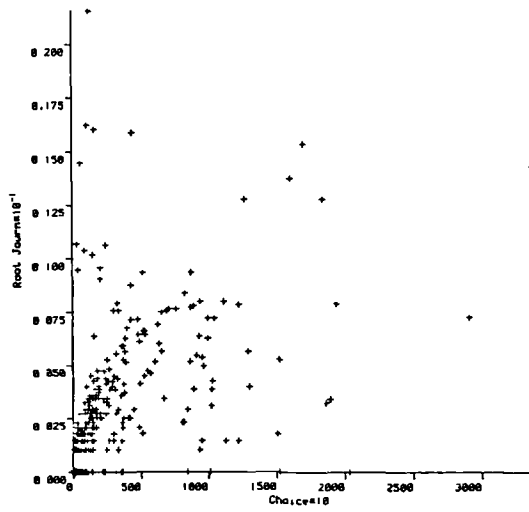
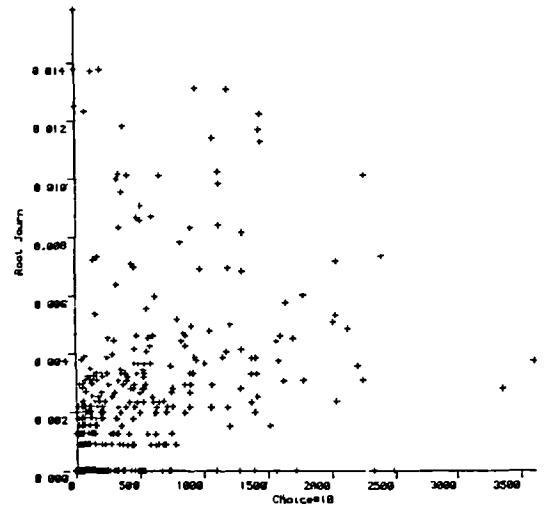
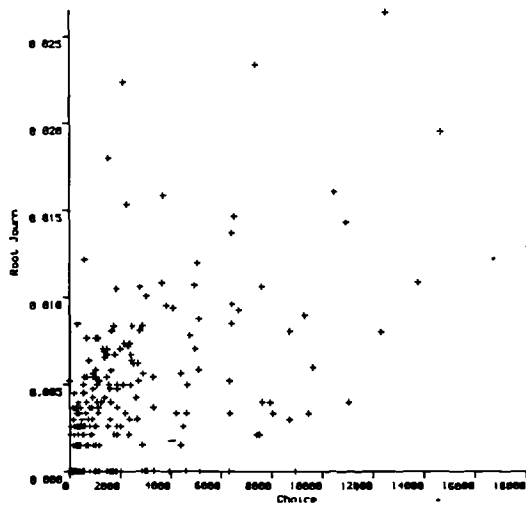
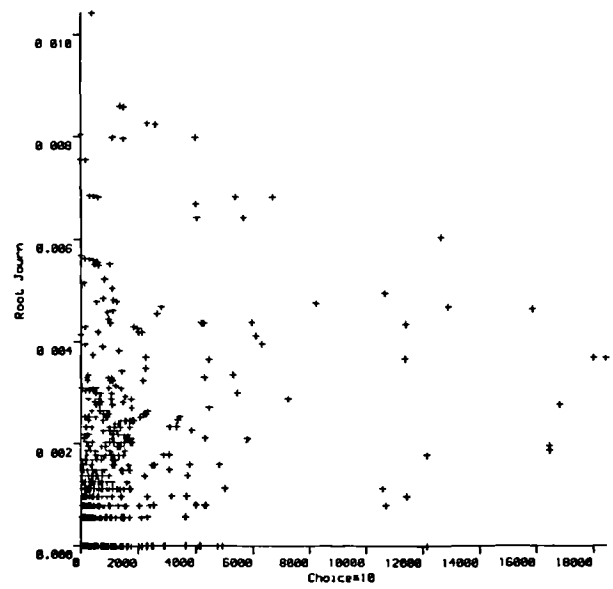
ALGIERS

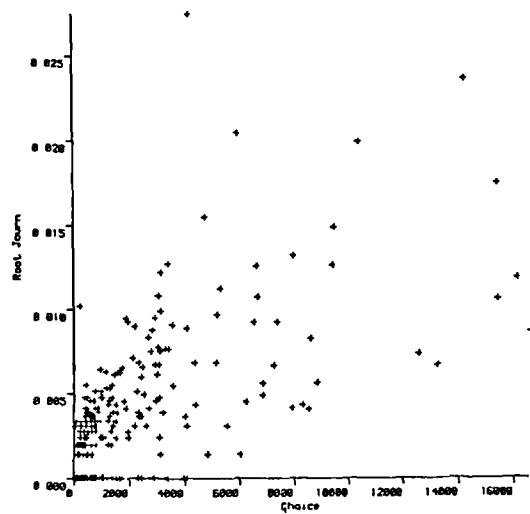


SALE

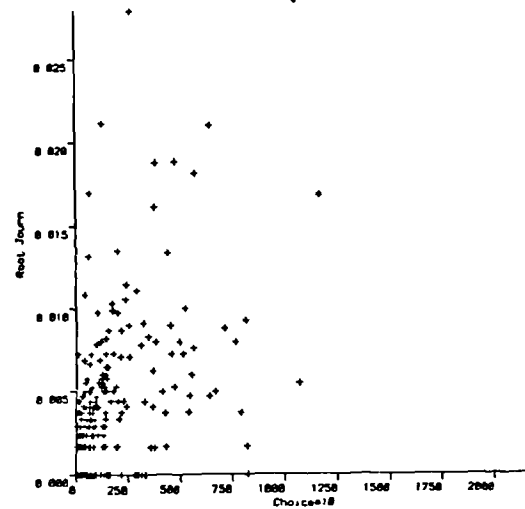


SUSA

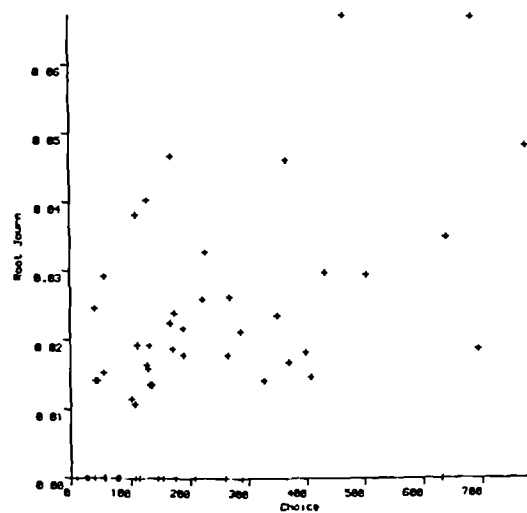
**TANGIER****CONSTANTINE****MEKNES****FEZ**



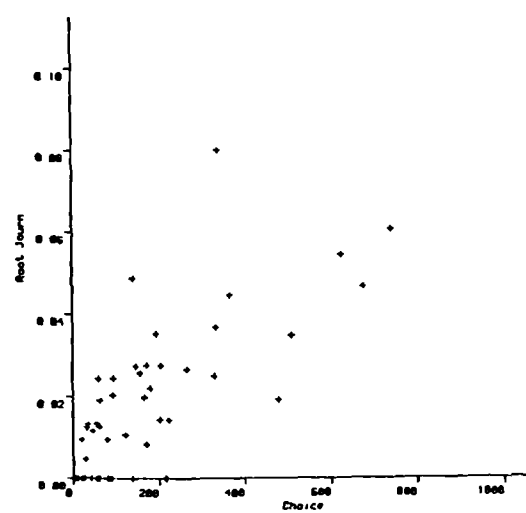
KAIRWAN



WARGLA



GUEMAR



TAMELHAT

APPENDIX 3: SUMMARY OF THE BRIEF OF THE MODERN HOUSING LAYOUTS

The brief for new developments defines three types of settlements according to the size of the future population and the number of dwellings the settlement will contain. This will determine the type of facilities to be provided. For example, a settlement of "Type Two" will contain 250 to 350 houses, that is 1750 to 2500 inhabitants. A settlement of "Type Three" will contain 400 to 700 houses , that is 2800 to 5000 people. But the public facilities are usually designed to serve a larger population of 8000 to 10000 people, from the surrounding hinterland.

i- General design considerations of the brief:

The brief recommends the considerations of various types in the design proposals for the new environments. These can be summarized as follows:

- Technical considerations: A pre-requisite to all new developments is a careful analysis of the existing site features, such as location, land form and topography, climate which affect the technical decisions relating for example to drainage system. The site appraisal study is then designed to identify the development constraints, both natural and man-made (i.e., river, valley or existing infrastructure).
- Social considerations: Among the social considerations, the brief emphasises the importance of "family privacy" or more specifically the separation of the sexes and the protection of women from visual overlookings. This is regarded as an important cultural fact that

must be carefully considered in the design of new urban environments.

The brief specifies the provision of the following facilities for a housing scheme of "Type Two": a mosque; a "hammam" (public bath); Community services: such as a post office, office building for administrative activities, a bank and a fire station. The new settlement will have a small range of shopping facilities. The shops will vary in size and number depending on the size of population they serve. Provision of cafes and restaurants will be also made. The brief recommends also the provision of a small market area to meet the more traditional form of trading. The size of the market will be determined in relation to its catchment area. The scheme will also include service-industry workshops, as all new developments need small businesses to service various day-to-day requirements. Such businesses include workshops for small repairs, bakery, a community laundry, a petrol filling station.

The brief recommends the provision of primary school with adequate outdoor play space will be made. Nursery schools with playgrounds are also required for a scheme of "Type Two", which will also include the provision of a health clinic and a youth centre with a large multipurpose room that would be used as a gymnasium, public meeting room, theatre or for film projection. The centre will also comprise a library and a reading room.

Some recommendations concerning the location of the public facilities in relation to each other and with respect to the whole settlement have been made by the study carried out by Lesbett. Using

questionnaires and interviews with the population of the surveyed villages, Lesbett has concluded that for example, the mosque must be centrally located, but not in close proximity to the cafe (Lesbett D., 1983, p. 251). The public bath on the other hand, must be located close to the centre with access more off-centre (i.e., on a side road). A more centralized access of the "hammam" puts women in direct acquaintance with men (ibid, pp. 251-252). The cafe and restaurant, a male facility per excellence, must be separated from the public bath and the health clinic, because of the female attendance, must have its access away from the cafe. The main problems raised in relation to the location of the school is noise generated by the children and danger of traffic (ibid, p. 250). Lesbett concludes that a school must be located outside the residential areas, but not close to any main traffic roads as not to endanger the children.

ii- Schedule of accomodation:

The following table summarizes the built-up areas required for each the facilities as specified by the brief.

FACILITY	BUILT-UP AREA (m2)
Mosque	350
Public bath	150
Community services	175-320
Shops	385
Cafe/Restaurant	140-210
Market	120
Workshops	120-250
Education facilities	2150
Health clinic	175
Youth centre	350-525
Petrol filling station	150

Table A3.1: Schedule of accommodation of public facilities

iii- Housing requirements:

The design standards restrict the size of the plots for the individual houses to 110-170 m². Each plot will have an initial built-up area varying between 45 to 70 m², dictated by construction costs (ibid, p. 131). Each house will also have an internal court, and openings to the outside are limited to the minimum (ibid, pp. 226-228). Lesbett carried out a survey on houses with windows giving onto the outside and found that in many cases, the windows are either kept always closed or blocked up and built (ibid, pp. 226-228). In this type of development, the houses consist of one single storey building, grouped in various ways.

iv- Road requirements:

- With regard to access roads: These roads will provide direct access from frontage properties. They are two-lanes roads with sidewalks of 1 metre wide and a right of way of 6 metres.
- With regard to the main road: Direct access from frontage properties is also permitted. This road type will be also a two-lanes road with sidewalks and its right of way is 8 metres. This road type will serve many of the public facilities and therefore will provide side parking for cars. Car ownership in this type of developments is likely to be very low and the brief recommends a limited provision for car parking of 1 parking space for every 10 houses. For road articulations, the brief recommends to avoid using "staggered" junction. For important cross-junctions, roundabouts are preferred to traffic lights.

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